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THE IRON TRADE REVIEW
MIDLAND SPECIAL

VOLUME XXXII. CLEVELAND, O. MAY 11, 1899. CHICAGO, ILL. NUMBER 19

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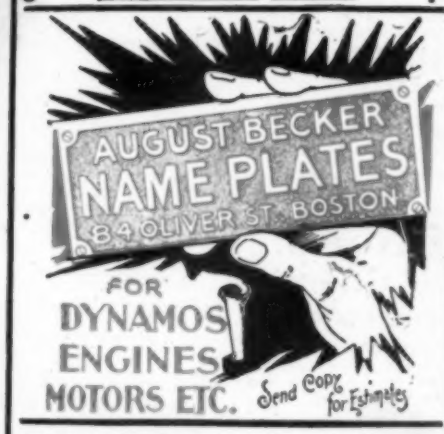

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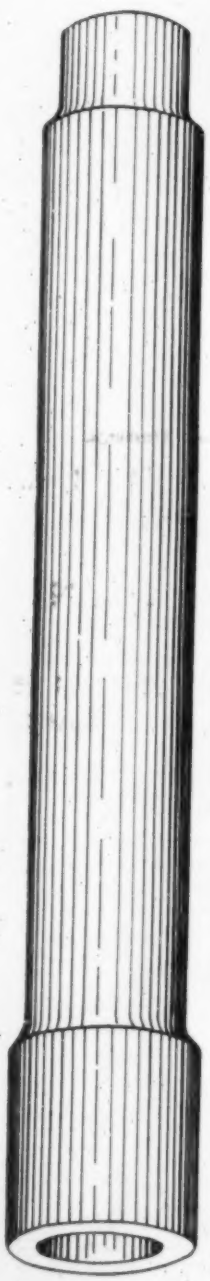

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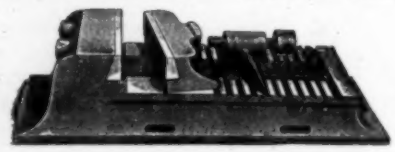

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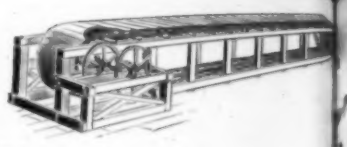

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THE IRON TRADE REVIEW

VOLUME XXXII. CLEVELAND, O. MAY 11, 1899. CHICAGO, ILL. NUMBER 19

THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

The iron trade has gone through another week of consolidation rumors, but in this case with some tangible outcome. As indicated in this column a week ago, the report of a merger of all the consolidations thus far made, in a new company, to include also the Carnegie Steel Co., Ltd., had no substantial basis; but the official announcement of the sale of Mr. Carnegie's interest to his partners and of the consolidation of the Carnegie Steel Co., Ltd., the H. C. Frick Coke Co. and their allied interests in a great company capitalized on a present day basis, has caused the liveliest speculation as to details and outcome. At the moment no changes in the iron trade seem likely to flow from this move; but it would be presumption, indeed, to attempt to say what the outcome is or is not to be. The fact that the Moore Bros., who with their associates have the control of the National Steel Co., American Tin Plate Co. and American Steel Hoop Co., are at work with Mr. Frick in financiering the latest deal, points to a close relation between the large steel producing interests of the Central West, and the maintenance of remunerative prices. It scarcely need be said that the problem of maintaining a peaceable footing with the Federal Steel Co. will not be a difficult one. The American Steel & Wire Co. is now a buyer from all three of the largest steel companies, and its relations with all are harmonious. It is a noteworthy fact that the weakening of various iron and steel stocks the past week, as the props were taken out from under the stories of an all-absorbing combine, has been accompanied by a strengthening of prices. The indications are that the question uppermost in the trade for the past six weeks, whether the second half of the year is to show an easing of prices, has now been settled in the negative. There is no shrinkage in demand, and each week finds furnaces and steel works with less material to sell for 1898 delivery. The feature of selling in the Central West the past week has been transactions in gray forge. Altogether the American Steel Hoop Co. has taken 30,000 tons for its Pittsburg and valley plants, and the price of Southern forge has gone to $10.75, Birmingham. In certain foundry grades Southern furnaces also made a 25-cent advance. Bessemer iron is 50 cents higher. On an inquiry for 25,000 tons the valley furnaces have quoted $15, furnace, or $15.65 Pittsburg, but the sale has not yet been closed. The American Steel & Wire Co. is reported to have been in the market for billets. The price is stronger, and $26.50 and $27, Pittsburg, has been the basis of recent 1,000 ton lot sales, while the anomaly is presented of rails at $2 a ton less. The Republic Iron & Steel Co. organization was scheduled to be completed this week. The constituent plants are not provided with iron beyond July, with but one or two exceptions. Meantime sellers of forge iron, both North South, have comparatively little iron to offer for delivery in the second half of the year.

PITTSBURG.

OFFICE OF *The Iron Trade Review and Industrial World.*
705 PUBLICATION BUILDING, May 10.

No positive information is yet at hand relative to any arrangements between the big steel producing interests, beyond the now established fact that the leading local steel interest is being reorganized from a limited partnership into a regular stock company, the head of the concern selling out, the official statement being that the sale is made to his partners, nothing being said as to how the funds for the purchase are being provided. Report has it that the present reorganization, which is self-contained, may be followed by a further deal in which outside interests will figure. The allied interests of the concern are being taken into the new corporation.

The week has developed a decided change in the tone of the market from the level maintained for some time, and the movement has been in the direction of greater strength. There is every reason to believe that the question as to which way the market would go for the balance of the year, or at least for the summer months, has now been answered. The conservative element is making renewed efforts to steady matters and hold prices down, but the tendencies in favor of higher prices are all but too strong for them. It is evident that the consolidation and combination movement has practically nothing to do with the course prices have been taking, for the loss of faith in the too hastily promulgated story of a union of the leading steel interests has had a very depressing effect on all the steel stocks in the first half of the week, while the market for the products decidedly strengthened in the same period. The continued talk of there being too wide a margin between pig iron and steel has resulted in nothing so far, each line having strengthened in about equal ratio in the week under review, leaving the disparity, if such it was, as great now as ever.

The general strength of the market is predicated mainly upon heavy sales of gray forge iron, advancing the price by about half a dollar a ton, an advance of the same amount in Bessemer pig iron, with the final closing out of all the outside iron, and an advance in steel.

PIG IRON.—Scarcely any Bessemer pig has been sold by the associated furnaces since the heavy sales some time ago, when selling for the third and fourth quarters was commenced. At a meeting held in Cleveland last Saturday the price committee acted upon an inquiry for 25,000 tons for the second half, and fixed a price of $15, valley furnace, for this quantity. The sale has not been consummated yet, and may not be until near the close of the week. Beyond this lot no price is made, but for purposes of comparison the market may be regarded as established at $15 valley and $15.65 Pittsburg Some Pittsburg furnaces regard much higher prices as probable by the middle of the year. A lot of 2,500 tons of storage iron at New Castle was closed out within the week at $14.50, and this constitutes, so far as known, the last of the "outside iron." There have been some heavy sales of gray forge during

the past ten days, a considerable quantity being Southern iron. It is understood that the American Steel Hoop Co. was the leading purchaser. The sales began at about $14.40, and extended up to nearly $15, Pittsburg. Scarcely anything lower than this can be done at Pittsburg, and the valley market is almost as high. In foundry irons the condition continues one of strength, and the regular producers have been selling lots now and then for prices a trifle higher than last quoted. One Shenago Valley furnace, which has just entered the market, has been quoting considerably under the figures at which sales have been made elsewhere, and this constitutes the only tendency to weakness in the market. We note considerable sales of No. 2 foundry at from $15.75 to $16, delivered Pittsburg. We quote prices as follows:

Bessemer, valley furnace	$15.00
Bessemer, Pittsburg	15 65
No. 1 Foundry	16.00 to 16.25
No. 2 Foundry	15.75 to 16.00
No. 3 Foundry	15.25 to 15.75
Gray Forge, valley furnace	14.50 to 14.75
Gray Forge, Pittsburg	14 85 to 15 00

STEEL.—The market for steel billets and slabs is considerably stronger. We note sales at $26.50 for deliveries during the third quarter, and for deliveries during the coming four months at slightly higher figures. For prompt delivery as high as $27 and $27.50 has been paid in some cases, and the market for more extended deliveries may be quoted firm at $26.50 to $27. It is reported that the American Steel & Wire Co. has been in the market for the past week. The mills can furnish scarcely any material from now to July 1, and cannot make easy deliveries until the latter part of the third quarter. There is no disposition to force sales for extended deliveries, and full confidence is expressed in the maintenance of present prices.

FERRO-MANGANESE.—This line is quoted unchanged at $75 for domestic, 80 per cent in large lots, and higher prices for smaller quantities.

RAILS AND TRACK MATERIAL.—The rail situation is quiet with no change in the scheduled price, $25, which is considerably below the price of billets at present. In track material prices of spikes and links and pins are $2 a ton higher, and the demand in all lines is very good. We now quote: Spikes, 1.90c to 2c; track bolts, 2.20c to 2.40c; splice bars, 1.50c to 1.70c; links and pins, 1.90c to 2c.

BARS.—There is no change to be reported in either steel bars or iron bars. We quote the former at 1.65c to 1.70c. and the latter at about $1 a ton lower.

STRUCTURAL MATERIAL.—Orders for structural material are coming in freely. The prices are unchanged, it being considered inadvisable to make any further advance, at least for the present. We quote prices unchanged, as follows: Beams and channels, 3 to 15 inches, 1.50c; 18 to 24 inches, 1.60c; tees, 1.55c; zees, 1.50c, and angles, 1.50c to 1.55c; universal mill plate, 2c.

PLATES.—The plate market continues very firm. For prompt delivery as high as 2.20c would have to be paid for tank, while mills are comfortably filled with orders pretty well through the third quarter. In some cases the prices for second and third quarters are shaded for deliveries to the close of the year, but the general rates are as follows: Tank, 2.10c; shell, 2.20c; flange, 2.30c; fire box, 2¾c to 3¼c.

PIPES AND TUBES.—At a meeting held the latter part of last week merchant pipe was advanced by changing the additional discounts from four 10's to three 10's, which made a net advance of a shade over 10 per cent. At the same time lap weld casing, both inserted and screw and socket joint, was advanced about 5 per cent, the discounts being decreased by 2½ per cent each, gross. The market is very firm and orders are being offered to one mill after another without being accepted, there being scarcely any available capacity for some months to come. The consolidation project seems to be working very slowly, and no further developments can be reported. We now quote the market as follows: Merchant pipe, base discoun t60 per cent and additional discounts three 10's for less than carloads and four 10's and 5 for carloads, with free delivery on the latter within the prescribed territory; lap weld casing, 50 for screw and socket joint and 45 for inserted joint, with 5 per cent additional on carload orders; boiler tubes, 1¼ to 1½-inch, 45 per cent; 1¾ to 2½-inch, 55 for iron and 60 for steel; 2¾ to 6-inch, 60 for iron and 62½ for steel, all with an extra 5 per cent to dealers.

SHEETS.—The project to consolidate the sheet mills is making rapid progress and the deal may be consummated in a short time. The report that the various Wood mills, at McKeesport, Wellsville and in the East, would remain out of the consolidation is almost wholly erroneous. The deal when consummated will include practically all the sheet mills in the country, and if any are left out some arrangement will doubtless be concluded so that they will work in harmony with the consolidated interests. The mills can get scarcely any steel and are unprepared to take orders. Some small quantities of sheets can be found from second hands, on the basis of 2.90c to 3c for No. 28 common. Galvanized is also very scarce, and 70 and 5 per cent off is the lowest price that could be secured, while the tonnage available is very limited.

SPELTER.—The spelter market has moved up a trifle since last report and is very firm. The Pittsburg market has been quite active. We now quote: St. Louis, 6.65c; Pittsburg, 6.80c; New York, 6.85c to 6.90c.

OLD MATERIAL.—With the opening up of the country roads scrap yards are receiving considerable material, and prices are a trifle easier in some lines. We quote the market, and quotations remain unchanged as follows: New melting stock, $13.50 to $13.75; old steel rails, long lengths, $12.50 to $13; cut, $13 to $13.50; old iron rails, $17 to $17.50; wrought iron scrap, $14 to $15; cast borings, $8, net, Pittsburg; busheling scrap, $11 to $11.50, net; car wheels (nominal), $14 to $14.50, gross; cast scrap, $12, gross; charcoal scrap, $13, gross; wrought turnings, $8.50 to $9, net, Pittsburg.

COKE.—The coke market is very strong. Production is being shoved to the utmost to keep blast furnaces going, and there is a good demand for foundry coke. There are occasional sales of furnace coke, and with the general advance in wages in the Connellsville region, the price for furnace coke has become strong at $2. We quote as follows: Strictly Connellsville furnace coke, $2; foundry and crushed, $2.30 to consumers, and $2.15 to dealers.

CHICAGO.

OFFICE OF *The Iron Trade Review and Industrial World*
1522 MONADNOCK BLOCK, May 10.

Sales of raw material increased somewhat last week, although they were not especially large. Buying in finished material was as heavy as it well could be with the mills holding off from selling as they are. The demand for all classes of material appears to be growing, and a buying movement is expected in June which may send prices higher. The principal talk of the week is of the consolidations accomplished and proposed. The Republic Iron & Steel Co. holds its meeting for the election of officers and arrangement of details in New York this week. The United States Cast Iron Pipe & Foundry Co. opened its offices in The Rookery building this week. Nothing definite has been announced regarding the proposed consolidation embracing most of the large iron and steel interests, but it is the general opinion here that much must be done before any such deal can be accomplished.

PIG IRON.—Business has shown a considerable increase over that of the week previous, and included three or four round lots of iron. The demand appears to be on the increase, and quite a little buying is expected to be done this month, with a decided increase for next month. Southern furnaces have advanced their prices 25 cents a ton in the week, and one Northern furnace announces an advance of 50 cents. The other local furnaces maintain the old rates, but say they expect prices to be higher within a short time. Should the expected buying movement put in its appearance the last of this month or in June, there will undoubtedly be a considerable advance in values. Quotations are as follows:

Lake Sup. Charcoal	$17 00 @ $18 00	Southern Coke No. 3	$15 00 @ 15 50
Local Coke Fdy. No. 1	15 50 @ 15 75	Southern No. 1 Soft	16 00 @ 16 50
Local Coke Fdy. No. 2	15 00 @ 15 50	Southern No. 2 Soft	15 50 @ 16 00
Local Coke Fdy. No. 3	14 50 @ 14 75	Southern Silveries	15 50 @ 16 00
Local Scotch Fdy. No. 1	15 50 @ 15 75	Jackson Co. Silveries	17 00 @ 18 00
Local Scotch Fdy. No. 2	15 00 @ 15 50	Ohio Strong Softeners	15 50 @ 16 50
Local Scotch Fdy. No. 3	14 50 @ 14 75	Alabama Car Wheel	17 50 @ 18 00
Southern Coke No. 1	16 00 @ 16 25	Malleable Bessemer	15 50 @ 16 00
Southern Coke No. 2	15 50 @ 16 00	Coke Bessemer	15 50 @ 16 00

BARS.—Very little business has been done, owing to the fact that the mills going into the Republic Iron & Steel Co., with very few exceptions, are not making sales. The demand has been good, and were the mills in position to take business orders would aggregate a large tonnage. The market in this waiting condition, is unchanged. Common iron is selling at 1.60c to 1.70c, and soft steel bars at 1.65c to 1.75c, half extras.

STRUCTURAL MATERIAL.—Sales last week were not large, no especially large contracts having been closed. The demand is somewhat lighter than it has been, and mills do not expect a large tonnage for the next few weeks. The market is firm and unchanged. Quotations are as follows: Beams, 15 inches and under, 1.65c to 1.70c; 18 inches and over, 1.75c to 1.80c; angles, under 3 inches and over 6 inches, 1.75c to 1.80c; 3 inches to 6 inches, 1.65c to 1.70c. Sheared plates, 2.25c to 2.30c; universal plates, 2.25c to 2.30c; tees, 1.70c to 1.75c; zees, 1.65c to 1.70c. Small lots from stock are quoted at ¼c to ½c higher.

BILLETS AND RODS.—The local mills made no sales of either billets or rods last week, and can take very little business, owing to the condition of their order books, which are well filled for some time ahead. Prices are about as follows: Bessemer billets, $26 to $27; open-hearth billets, $29 to $30; rods, $34.50 to $36.50.

PLATES.—The demand for plates continues good, and sales from store are of excellent proportions. Mill orders are not sought after, as the mills are not in position to take much business for anything like immediate delivery. Quotations are unchanged as follows: Tank plates, 2.25c to 2.30c; flange steel, 2.35c to 2.45c; marine steel, 2.45c to 2.55c; fire box steel, 3c and upwards.

SHEETS.—Mills are well sold ahead, and have refused business in the week, in many cases. Orders for store shipment are good, and are likely to continue so. Prices are higher at 2.85c to 2.90c for No. 27 black, and 70 and 10 to 75 per cent off for galvanized.

MERCHANT STEEL.—Business was mostly in small lots, and even these it is difficult to place with the mills, owing to their heavily oversold condition. Store business is as large as the stores can well handle. Quotations are as follows: Open-hearth spring, tire and machinery steel, 2.40c to 2.45c; smooth-finished machinery steel, 2.45c to 2.55c; smooth-finished tire steel, 2.25c to 2.35c; tool steel, 6c to 7.50c; special, 10c and upwards.

RAILS AND TRACK SUPPLIES.—No sales sales are reported for the week in either light or standard sections. We quote: Standard section rails, $26 to $27; light rails, $26 and upwards; steel splice bars, 1.40c to 1.50c; track bolts with square nuts, 2.15c to 2.25c; hexagon nuts, 2.25c to 2.30c; spikes, 1.85c to 1.90c.

WIRE AND WIRE NAILS.—Sales have been good and show every indication of keeping up. The demand increases rather than diminishes. Prices are as follows: Plain wire, $1.95; galvanized No. 14 and heavier, 50c advance; Nos. 15 and 16, 85c advance; Nos. 17 and 18, $1.10 advance; wire nails, $2.10; barb wire, painted, $2.20; galvanized, $2.70. All prices are f. o. b. Pittsburg and on carload shipments all rail freight is added, making a delivered price. Single carload lots are quoted 10c higher.

SCRAP.—The bar mills are not buying, pending the organization of the Republic Iron & Steel Co., and other buyers appear to have satisfied their wants for the immediate future. A heavier demand is expected to come before the end of the month, when the bar mills will probably be in the market for their supplies. Prices are unchanged. Dealers' quotations are about as follows:

Old iron rails, gross	$18 50 @ $19 00	Axles, net	$19 00 @ $20 00
Old steel rails, long, gr.	13 00 @ 13 50	Cast borings, net	6 00 @ 6 50
Old steel rails, short	11 50 @ 12 00	Wrought turnings, net	8 50 @ 9 00
Old wheels, gross	16 50 @ 17 00	Axle turnings, net	10 00 @ 10 25
Railroad forge, net	16 50 @ 17 00	Mixed steel, gross	8 00 @ 8 50
Dealer's forge, net	12 00 @ 15 00	Stove plates, net	9 00 @ 9 50
No. 1 mill, net	10 50 @ 11 00	Heavy melting steel, gr.	10 50 @ 11 00
Heavy cast, net	13 00 @ 13 25	Old iron splice b., net	18 50 @ 19 00
Malleable cast, net	8 50 @ 9 50		

Ore Stocks on Lake Erie Docks May 1.

Figures furnished *The Iron Trade Review* directly from Lake Erie docks show that the amount of ore at lower lake ports May 1 was the smallest in seven years, save 1896, when stocks were about 125,000 tons less than at the beginning of the present month. The aggregate is 2,073,254 gross tons, as against 3,167,915 tons on May 1, 1898, 3,256,497 tons May 1, 1897, and 1,949,698 tons in 1896. The tables below show stocks on docks on May 1, in 1897, 1898 and 1899, by ports, with the amount on dock at the close of navigation in 1896, 1897 and 1898:

Ports.	CLOSE OF NAVIGATION.			OPENING OF NAVIGATION.		
	Dec. 1, 1896.	Dec. 1, 1897.	Dec. 1, 1898.	May 1, 1897.	May 1, 1898.	May 1, 1899.
Toledo	115,959	194,644	146,568	66,337	71,726	23,915
Sandusky	59,491	84,786	48,500	48,937	48,800	7,086
Huron	200,075	230,029	139,982	162,292	143,170	82,055
Lorain	231,268	317,509	324,034	180,605	158,797	168,646
Cleveland	1,419,311	1,478,351	1,175,970	979,703	853,776	472,946
Fairport	773,905	825,312	719,794	480,984	501,592	269,417
Ashtabula	1,441,668	1,835,694	1,732,671	926,865	1,031,441	855,691
Conneaut	275,801	360,895	288,101	207,034	69,047	6,115
Erie	355,222	484,871	439,167	153,261	236,488	95,626
Buffalo	82,267	121,660	121,620	50,477	53,081	72,757
Total	4,954,984	5,923,755	5,136,407	3,256,495	3,167,915	2,073,254

The total rail shipments from Lake Erie ports to furnaces in the winter of 1898–9 appear by comparing dock stocks Dec. 1, 1898, and May 1, 1899:

	Gross Tons.
On dock at Lake Erie ports, Dec. 1, 1898	5,136,407
On dock May, 1899	2,073,254
By rail to furnaces in the winter of 1898-9	3,063,153

The shipments to furnaces in the seven months from May 1 to Dec. 1, 1898, together with the consumption by furnaces at Tonawanda, Buffalo and Cleveland, receiving ore direct into their yards from vessels, amounted to 9,059,829 tons. Thus the total shipments from Lake Erie ports to furnaces in the year ending May 1, 1899, were 12,122,982 tons. These shipments in the past eight years have been as follows:

Year Ending—	Gross tons.	Year Ending—	Gross tons.
May 1, 1899	12,122,982	May 1, 1895	6,297,215
May 1, 1898	10,209,488	May 1, 1894	4,840,488
May 1, 1897	6,719,633	May 1, 1893	6,102,125
May 1, 1896	8,805,510	May 1, 1892	5,802,496

The statement of winter shipments for 12 years is as follows in gross tons:

1898-9	3,063,153	1894-5	2,191,267	1890-1	1,231,264
1897-8	2,755,840	1893-4	1,482,340	1889-90	1,870,878
1896-7	1,698,487	1892-3	2,053,654	1888-9	1,289,802
1895-6	2,466,014	1891-2	1,971,301	1887-8	855,141

For comparison we append the record of iron ore stocks on docks at the opening of navigation, back to 1890:

Year.	Gross tons.	Year.	Gross tons.
1899	2,073,254	1894	2,588,370
1898	3,167,915	1893	3,095,797
1897	3,256,497	1892	1,537,188
1896	1,949,698	1891	2,662,223
1895	2,642,980	1890	936,228

THE IRON TRADE REVIEW
AND
INDUSTRIAL WORLD.

DEVOTED TO MACHINERY, METAL-WORKING AND FOUNDRY TRADES AND IRON AND STEEL MANUFACTURE.

PUBLISHED EVERY THURSDAY BY
THE IRON TRADE REVIEW CO.,
CLEVELAND, OHIO.

CLEVELAND, 27 VINCENT STREET.
G. H GARDNER, President. A. I. FINDLEY, Editor.

CHICAGO:
1522 MONADNOCK BLOCK.
B. M. GARDNER, Associate Editor and Western Manager.

PITTSBURG:
705 PUBLICATION BUILDING.
B. E. V. LUTY, Manager.
Telephone 1302.

BOSTON: 16 Herald Bldg. | NEW YORK: 203 Broadway.

Subscription (strictly in advance), $3 per annum. Advertising Rates Furnished on Application.

The Cleveland News Co. will supply the trade with THE IRON TRADE REVIEW through the regular channels of the American News Co.

ENTERED AT THE POST OFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER

MAY 11, 1899.

A "MIDLAND SPECIAL" EDITION.

This issue of *The Iron Trade Review* is more than twice the usual size, the extra space being about equally divided between reading matter and advertising. The pages following speak for themselves, and are an index to the section of the country in which history is now being made in the iron trade. Of the States in this section we have selected Illinois and Wisconsin for special attention in this issue—both not so long ago known only dimly as parts of the great West, innocent of the touch of factory smoke. Still surviving among the captains of industry in these two States are men who made the first ventures in manufacturing within their borders. The achievement of the past 30 years has been marvelous; yet who shall say that far greater things are not reserved for the generation of managers just coming into prominence?

The changes in the iron trade and in indusrties dependent upon it have come fast since the opening of the new year, and it is easy to believe that a canvass of the Chicago and Milwaukee districts one year hence would show fewer firm names than appear to-day. But none can doubt that the industrial position of the great Central West will be even more secure in the years just ahead. Organizations may come and go, but the Middle West, with its splendid resources, is destined to be the industrial hive, not only of the United States, but of both hemispheres.

It is expected that committees from the Republic Iron & Steel Co. and the American Tin Plate Co. will be in Detroit during the coming session of the Amalgamated Association and confer with the workmen's committee, so that the scale may be agreed upon finally before the convention adjourns.

MR. CARNEGIE ON THE OUTLOOK.

Just before Mr. Andrew Carnegie's departure for Europe in the last week in April, *The Iron Trade Review* asked him for an expression concerning the course of the American iron trade in 1899 and the prospects for the farther future. His kind compliance with this request makes possible the presentation in our Midland Special edition of Mr. Carnegie's last trade utterance as an American steel master. The developments of the past week give special significance and interest to this communication:

"Concerning the prospects for business in 1899, of which *The Iron Trade Review* has asked me to speak, these are not in doubt. So many orders for the present year are on the books of manufacturers that it would require some very startling element to affect the result. I do not see any probability of the prevailing prosperity coming to an end before next winter—perhaps not then—although the rise in prices must tend to check consumption, and especially the export trade; but the difficulty now is to take care of the home demand—a demand which is legitimate, covering actual requirements, and not increasing stocks. Although the demand abroad is now so great, prices are still advancing, and we may find a market for considerable quantities, even at present prices here.

"When depression comes, the American manufacturer will have one reserve which has not hitherto been his, namely, he will be able to produce at a cost which will enable him to supply the world outside, and this fortunately will keep labor more fully employed than it has been hitherto under similar circumstances.

"Another element in his favor is the increased consumption of steel, its use for so many things; so that upon the whole I believe the industry to be upon more solid foundations than ever before.

"Upon one point I am well assured: that the increased demands of the world for iron and steel are chiefly to be met by the United States. Great Britain and Germany are now running up to their fullest capacity, although Great Britain shows this year even a slight decline in product. The demand which is to come beyond the present production is to be the prize of the American manufacturer; and unless the present activity creates capacity far beyond any possible demand, as is to be feared, manufacturers should obtain profitable prices for some time to come. The country has never entered upon a period of activity under conditions so favorable. Many years of inactivity and saving; splendid crops for two years sold at high prices to the foreigner; great advance in methods of production; an enormous trade balance in our favor—all these elements combined justify the optimistic views which prevail. Our iron and steel manufacturers deserve prosperity for a time for they have had a hard struggle for years." ANDREW CARNEGIE.

Mr. Carnegie's life story, which has been told and re-told perhaps fully as often as those of the

men who have won great names in more public walks, strikingly illustrates the genius of our American life. Easily chief among the captains of a great industry, he has built up an organization that probably has not a parallel in industrial achievement. What the American iron trade owes to the insight, courage, sagacity and indomitable purpose of this one man cannot be appreciated from this close view-point. But it is to be said in a word, that Andrew Carnegie and his co-workers have been no small factor in the swift development that has put the United States in command of the steel trade of the world. Certainly such achievement as Mr. Carnegie's has earned him all the honors that useful retirement and well-bestowed wealth can bring.

The New Carnegie Steel Co.

All the rumors of the past two weeks concerning aggregations in the iron trade, with absorbing capacity ranging all the way from two companies to practically the entire steel industry of the country, have come to the outcome indicated in these columns one week ago in this statement: "The truth seems to be that the Moore Bros. and associates have been negotiating for a considerable interest in the Carnegie Steel Co., Ltd., and some early outcome from the negotiations may be expected. . . . It is unlikely in any event that the Carnegie Steel Co. will be actually consolidated with any other steel company. However, close trade relations between the Carnegie Steel Co. and the National Steel Co., American Tin Plate Co. and American Steel Hoop Co. may result from negotiations under way."

The chief development of the week has been the announcement of Mr. Andrew Carnegie's retirement from the organization which he has made the most notable in American industrial history, the purchase of his interest by his partners and the incorporation of the Carnegie Steel Co. in New Jersey, preparatory to its capitalization on a scale corresponding to current ideas in industrial financiering. That this is all that the present movement contemplates is indicated in the following statement given to the press by Mr. H. C. Frick:

"The current rumors that the Carnegie Steel Co., Ltd., and the H. C. Frick Coke Co. contemplated combination with other steel interests were wholly unfounded. What was in contemplation, and what is now practically consummated, is the amalgamation under one corporate organization of all of the properties and interests of the Carnegie Steel Co., Ltd., and the H. C. Frick Coke Co., and their subsidiary and allied organizations. Practically the only changes in the situation will be the retirement of Mr. Andrew Carnegie from the organization, he having sold to his partners his entire interest; Mr. Carnegie's intention being to give his entire time in the future to the prosecution of his great philanthropic work. With reference to the charters which have been obtained in Pennsylvania and New Jersey, there is nothing to say at present, but it should be well understood that there will be no change in the management of the various companies."

On Friday, May 5, the day the above was given out, the Carnegie Steel Co. was incorporated at Trenton, N. J., with a capital of $2,000, which is to be expanded later to such proportions as may be determined on the completion of the present negotiations for the financing of the great deal.

In spite of the efforts of stock-jobbing coteries, some of them quite closely in touch with the iron trade, to convince the public that a great combination, with from $800,000,000 to $1,000,000,000 was in process of formation, the information which can now be published establishes the fact that so far as the plans of Mr. Frick and his partners and the Moore Brothers and their associates go, only the merger of the present Carnegie Steel Co., and the organizations allied to them, is contemplated.

It has been known for the past two weeks that just before sailing for Europe on April 25, Mr. Carnegie, after long conferences at New York with his partners, put his interests in the hands of Henry Phipps, Jr., and H. C. Frick on terms which opened the door for the movement now fully under way. Mr. Carnegie's attitude toward consolidations of the type of some recently formed is not unknown. But his decision to dispose of his interests to his partners, leaving them, if they so chose, to carry out the project now being launched, is reported to be rather in pursuance of a purpose long since formed. As stated by himself to a London interviewer, he made the sale "in pursuance of a policy I determined upon long since, not to spend my old age in business, struggling for more dollars. I believe in a useful, dignified and unselfish reign after the age of 60. Then a man should devote his energies to a wise administration of his surplus wealth, wherein so many philanthropists fail."

No official statement is made either as to the price paid for Mr. Carnegie's interest, which is a majority of the Carnegie Steel Co. holdings, heretofore on a $25,000,000 capitalization, and an important share of the H. C. Frick Coke Co. stock; but it is stated on good authority that Mr. Carnegie is to receive $100,000,000 of 5 per cent bonds of the new company. On the capitalization nothing authentic has been given out, but a total of $250,000,000 of preferred and common has been discussed.

As a preliminary step, notice has been given that on May 29 application will be made to the Governor of Pennsylvania for a charter for the Carnegie Steel Co., and that this Pennsylvania charter will be used to gather together all the distinctly Carnegie interests under one head, preparatory to their absorption by the New Jersey company. The head of the new Carnegie Steel Co., it need not be said, will be Henry Clay Frick, whose advance to a commanding position in the steel and coke worlds has been one of the remarkable chapters in American industrial development. At the age of 23 Mr. Frick made his first investment in coke ovens; in 27 years his interests have increased until to-day his company controls more than 80 per cent of the product of the Connellsville region.

THE CARNEGIE STEEL CO.'S INTERESTS.

The Carnegie Steel Co., Ltd., was formed on July 1, 1892, with a capitalization of $25,000,000. The first step in the formation of what now constitutes the vast Carnegie interests was made in 1864, when Andrew Carnegie and several others formed the Cyclops Iron Co., with a capital of $100,000.

In the succeeding 35 years many changes took place including the merging of various companies in which Andrew Carnegie, Thos. M. Carnegie, Henry Phipps, Jr., and others had an interest. Carnegie, Kloman & Co., was formed Dec.

1, 1870; the Edgar Thomson Steel Co., Ltd., on Oct. 12, 1874; Carnegie Bros. & Co., Ltd., April 1, 1881; Carnegie, Phipps & Co., Ltd., Jan. 1, 1886. The limited partnership of July 1, 1892, was formed by Andrew Carnegie, Henry Phipps, Jr., Henry C. Frick, George Lauder, William H. Singer, Henry M. Curry, Henry W. Borntraeger, John G. A. Leishman, William L. Abbott, Otis H. Childs, John W. Vandevort, Charles L. Strobel, Francis T. F. Lovejoy, Patrick R. Dillon, William W. Blackburn, William P. Palmer, Lawrence C. Phipps, Alexander R. Peacock, J. Ogden Hoffman, John C. Fleming, James H. Simpson and Henry P. Bope. The capital was full paid in.

The company maintains offices in all the large cities of the United States, and in London, and operates the finest system of iron and steel plants in existence. The present board of managers of the Carnegie Steel Co., Ltd., consists of H. C. Frick, chairman; Henry M. Curry, Charles M. Schwab, Alexander R. Peacock, Lawrence C. Phipps, George H. Wightman, Francis T. F. Lovejoy, James Gayley and Thomas Morrison. William H. Singer, for many years a prominent manager, remains as a consulting partner.

The following properties are to be included in the reorganization:

The Edgar Thomson Works, Bessemer, Pa., including Edgar Thomson blast furnaces, Edgar Thomson foundry, Edgar Thomson steel works.

The Duquesne Works, Duquesne, Pa., including Duquesne blast furnaces, Duquesne steel works.

The Homestead Steel Works, Munhall, Pa., including Bessemer steel department, open-hearth steel department, finishing mills, armor plate department.

The Carrie blast furnaces, Rankin, Pa.

The Lucy blast furnaces, Pittsburg.

The Upper Union mills, Pittsburg.

The Lower Union mills, Pittsburg.

The Larimer Coke Works, Larimer, Pa.

The Youghiogheny Coke Works, Douglass, Pa.

All the capital stock of the Carnegie Natural Gas Co., the Youghiogheny Water Co., the Mount Pleasant Water Co., the Trotter Water Co., the Union Railroad Co., the Slackwater Railway Co., and the Youghiogheny Northern Railway Co.

One-half the capital stock of the Pittsburg, Bessemer & Lake Erie R. R. Co.

All the coal and coke property of the H. C. Frick Coke Co., in Fayette and Westmoreland counties, Pa., including 40,000 acres of unmined coal, 20,000 acres of surface lands, 11,000 coke ovens, 2,500 railroad cars, 3,500 dwellings.

All the capital stock of the Pittsburg & Conneaut Dock Co.

43.6 per cent of the capital stock of the Pennsylvania & Lake Erie Dock Co.

One-fourth of the capital stock of the New York, Pennsylvania & Ohio Dock Co.

Five-sixths of the capital stock of the Oliver Mining Co., which owns all the stock of the Metropolitan Iron & Land Co., all the stock of the Pioneer Iron Co., 89.3 per cent of the stock of the Lake Superior Iron Co., and 98 per cent of the stock of the Security Land & Exploration Co.

One-half of the capital stock of the Pewabic Co.

Three-fourths of the capital stock of the Pittsburg Limestone Co., Ltd.

In 1898 the Carnegie Steel Co.'s pig iron production was 17 per cent of the output of the country, 36 per cent of that of Pennsylvania, and 66 per cent of that of Allegheny county. The company's Bessemer steel production was 22 per cent of that of the country and 42 per cent of that of Pennsylvania. In March last the shipments of iron and steel from the works—that is, of pig iron from furnaces and of finished steel from the various plants—were 458,695 tons. The total output of finished material for 1899 is estimated at 2,500,000 tons.

The company is now erecting a new universal mill, a plate mill and an axle plant with a capacity of 80,000 tons a year. Its land holdings in Allegheny county are 1,600 acres.

The H. C. Frick Coke Co. is the largest coke producer in the world, owning in the Connellsville coke region nearly 40,000 acres of coal and 11,000 ovens, with a daily capacity of 25,000 tons of coke. Upward of 11,000 men are employed.

The Oliver Iron Mining Co. has mines which will produce 4,000,000 tons of ore in 1899—some of the choicest and largest properties in the Lake Superior region.

Consolidations in the Iron Trade.

So rapidly have the amalgamation movements in the iron trade been consummated in the past five months that the average member of the trade has found it well nigh impossible to hold in mind the properties gathered together, so as to assign them on call to their appropriate places. Responding to a call that has come from many quarters, we present a recapitulation of the work of consolidation, so far as it has been completed. The record is not put forth as a finality; for it is entirely probable that the next few weeks will make further additions to it. Nor is it possible to give in this memorandum form all the facts that might be set down relative to these new companies. What is given is rather for purposes of ready identification, than to serve as a descriptive directory:

FEDERAL STEEL CO.

Constituent companies: Illinois Steel Co., Minnesota Iron Co., Elgin, Joliet & Eastern Railway Co., Lorain Steel Co., Lorain, O., and Johnson Co., Johnstown, Pa. Directors and officers: J. Pierpont Morgan, Robert Bacon, E. H. Gary, D. O. Mills, R. P. Flower, C. C. Cuyler, Chas. C. Cliff and Chas. McVeagh, of New York; Marshall Field, H. H. Porter, and Norman B. Ream, of Chicago; Samuel Mather, of Cleveland; Nathaniel Thayer, of Boston; Benj. C. Van Dyke, of New Jersey. Elbert H. Gary is president and general counsel; H. H. Porter, chairman of the board; Richard Trimble, secretary and treasurer. Main offices, New York. Constituent companies all retain separate organization and officers.

Capital stock issued, $99,737,800—$53,253,500 6 per cent noncumulative preferred, and $46,484,300 common. Bonded indebtedness $29,959,000 distributed as follows: Illinois Steel Co., $13,200,000; Elgin, Joliet & Eastern Railway, $7,417,000; Johnson Co., $1,600,000; Duluth & Iron Range Railway, $7,742,000. Annual bonded interest charges, $1,523,950.

Iron mines: Minnesota and Chandler, on the Vermillion range; Fayal, Auburn, Genoa, Norman, Canton, and Elba, on the Mesabi range. Vessels: Ten steamers and eight barges, with aggregate carrying capacity of 80,200 gross tons on an average depth of 17 feet 7 inches.

Annual capacity of Chicago district and Lorain plants, 2,250,000 tons of T-rails, girder rails, billets, sheet bars, rods, plates, track supplies, merchant bars, cotton ties, etc., in addition to foundry iron produced at South Chicago.

AMERICAN STEEL AND WIRE CO.

Capital stock issued, $85,250,000, of which $38,150,000 is 7 per cent cumulative and $47,100,000 common. Bonded indebtedness, $730,000. Officers: John W. Gates, chairman; John Lambert, president; Wm. Edenborn, 1st vice-president; J. L. Ellwood, 2d vice-president; S. H. Chisholm, 3d vice-president; P. W. Moen, 4th vice-president; W. A. Green, treasurer; F. L. Watson, assistant treasurer; Chicago; T. P. Alder, assistant treasurer, New York; C. S. Roberts, secretary; O. Owens, assistant secretary, Chicago; F. E. Patterson, assistant secretary, New York. Executive committee: I. L. Ellwood, chairman; J. W. Gates and Wm. Edenborn. Wm. P. Palmer, general manager; A. M. Crane, assistant general manager; C. T. Boynton, general sales agent; C. A. Honecker, auditor, C. A. Vogt, assistant auditor. Main offices, Chicago. Annual product, about 1,200,000 tons of wire rods, wire and wire nails.

The constituent plants are given below. They include, in addition to the rod, wire, wire nail and woven wire fence plants, the three blast furnaces of the Cleveland Rolling Mill Co., and Emma furnace, Cleveland; Edith furnace, of the Oliver & Snyder Steel Co., Pittsburg, and the two furnaces of the Shoenberger Steel Co., Pittsburg. The steel plants are those of the Cleveland Rolling Mill Co., the Oliver & Snyder Steel Co., the Shoenberger Steel Co., and the open-hearth plant of the Washburn-Moen Mfg. Co., Worcester, Mass. The iron mines are the Sauntry, on the Mesabi range,

and the Negaunee, on the Marquette range. Five vessels of the Zenith Transit Co. fleet have been bought, having an aggregate capacity of 29,000 tons:

Allentown Works, at Allentown, Pa.
American Works, at Cleveland, O.
Anderson Works, at Anderson, Ind.
Beaver Falls Works, at Beaver Falls, Pa.
Consolidated Works at Cleveland, O.
Elwood Works, at DeKalb, Ill.
Findlay Works, at Findlay, O.
H. P. Nail Works, at Cleveland, O.
Joliet Works, at Joliet, Ill.
Pittsburg Works, at Rankin Station, Allegheny County, Pa.
Rockdale Works, at Rockdale, near Joliet, Ill.
Salem Works, at Salem, O.
St. Louis Wire Mill, at St Louis, Mo.
Cincinnati Barbed Wire Fence Co., Fairmount, Cincinnati, O.
Cleveland Rolling Mill Co., Cleveland, O.
Consolidated Barb Wire Co., Joliet, Ill.
Indiana Wire Fence Co., Crawfordsville, Ind.
Laidlaw Bail Tie Co., Joliet, Ill.
Newburgh Wire & Nail Co , Newburgh, N. Y.
New Castle Wire Nail Works, New Castle, Pa.
Oliver & Snyder Steel Co., Pittsburg, Pa.
Oliver Wire Co., Pittsburg, Pa.
Pittsburg Wire Co., Braddock, Allegheny County, Pa.
Washburn & Moen Mfg. Co., Worcester, Mass. Works at Worcester, Mass., and at Waukegan, Ill.
Worcester Wire Co.. Worcester. Mass.
Shoenberger Steel Co., Pittsburg, Pa.
Portage Iron Co., Ltd., Duncansville, Pa., rod mill, wire and nail mills.
Puget Sound Wire Nail & Steel Co., Everett, Wash.
McMullen Woven Wire Fence Co., Evanston, Ill.

AMERICAN TIN PLATE CO.

The American Tin Plate Co., the first of the recently formed consolidations, now enjoys a complete monopoly of the tin plate manufacturing business in the United States. Its plants, taken as a whole, are the newest of any, and the arrangements of the company for exclusive supply in machinery and raw material go further than those of any of the other consolidations. The capital is $50,000,000—$20,000,000 7 per cent cumulative preferred and $30,000,000 common. The officers are: D. G. Reid, president; W. B. Leeds, 1st vice-president; W. T. Graham, 2d vice-president; Warner Arms, 3d vice-president; W. H. Dutton, secretary; F. S. Wheeler, treasurer; E. G. Applegate, assistant to secretary and treasurer. Executive committee, W. B. Leeds, chairman; D. G. Reid, W. T. Graham, WarnerArms, W. H. Moore. Directors: D. G. Reid, W. ,H. Moore, James McLean, James B. Dill, F. S. Wheeler, Warner Arms, George Greer, W. H. Donner, Cecil A. Robinson, Wm. E. Reis, James A. Matthews, Richard R. Quay, James H. Moore. Headquarters, Marquette Bldg., Chicago.

There are only two plants in the country making black plates for tinning which are not owned by the American Tin Plate Co. These are the 8-mill plant of the St. Louis Stamping Co., taken into the National Enameling & Stamping Co., and the 4-mill plant of the Lalance & Grosjean Mfg. Co., at Harrisburg, Pa. The National Enameling & Stamping Co. is now working in close harmony with the American Tin Plate Co., while the product of the Harrisburg plant is consumed in the Lalance & Grosjean Mfg. Co.'s tinware plant. A two-mill plant projected long before the American Tin Plate Co., was organized, is now being built at Avonmore, Pa.

Following is a complete list of the concerns whose properties were purchased, with the number of hot mills, some having separate roughing stands, and all having the complement of cold mills:

Aetna-Standard Iron & Steel Co., Bridgeport, O., 8 mills.
American Tin Plate Co., Elwood, Ind., 20 mills at Elwood and 6 mills at Montpelier.
Atlanta Steel & Tin Plate Co., Atlanta, Ind., 5 mills.
Baltimore Tin Plate Co., Locust Point, Baltimore, Md., 4 mills.
Beaver Tin Plate Co., Lisbon, O., 6 mills.
Blairsville Rolling Mill & Tin Plate Co., Blairsville, Pa., 2 mills.
Britton Rolling Mill Co., Cleveland, O., 3 mills.
Canonsburg Iron & Steel Co., Pittsburg; works at Canonsburg, Pa.; 8 mills, 3 not entirely completed.
Cincinnati Rolling Mill & Tin Plate Co., Cincinnati, O., works at Riverside, 4 mills.
Crescent Sheet & Tin Plate Co., Cleveland, 6 mills.
Cumberland Steel & Tin Plate Co., Cumberland, Md., 5 mills.
Ellwood Tin Plate Co., Cleveland, O., works at Ellwood City, Pa., 5 mills.
Falcon Tin Plate & Sheet Co., Niles, O., 6 mills.
Great Western Tin Plate Co., Chicago, Ill., works Joliet, Ill., 4 mills.
Hamilton & Co., West Newton, Pa., 2 mills.
Humbert Tin Plate Co., Connellsville, Pa., 6 mills.
Irondale Steel & Iron Co., Richmond, Ind., works, Middletown, Ind., 6 mills.
Johnstown Tin Plate Co., New York City, works, Johnstown, Pa., 2 mills.
La Belle Iron Works, Wheeling, W. Va., 10 mills.
Laughlin Nail Co., Martins Ferry, O., 14 mills.
Marshall Bros. & Co., Philadelphia, Pa., 6 mills.
Monongahela Tin Plate Co., Pittsburg, Pa., 14 mills.
The Morewood Co., Gas City, Ind., 8 mills.
Morton Tin Plate Co., Cambridge, O., 6 mills.
National Tin Plate Co., Anderson, Ind., 6 mills, 1 being added.
National Tin Plate Co., Monessen, Pa , 9 mills.
Neshannock Sheet & Tin Plate Co., New Castle, Pa., 6 mills.
New Castle Steel and Tin Plate Co., New Castle, Pa., 20 mills.
Ohio River Sheet & Tin Plate Co., Remington Station, Pa., 2 mills.
Pennsylvania Tin Plate Co., New Kensington, Pa., 6 mills.
Pittsburg Tin Plate Works, New Kensington, Pa., 6 mills.
Reeves Iron Co., Canal Dover, O., 6 mills.
Shenango Valley Steel Co., New Castle, Pa., 30 mills.
Somers Bros., Somerton Tin Plate Works, Brooklyn, N. Y., 3 mills.
Star Tin Plate Co., Pittsburg, Pa., 8 mills.
Stickney Iron Co., Baltimore, Md., 2 mills.
United States Iron & Tin Plate Mfg. Co., Demmler, Pa., 11 mills.
Wallace, Banfield & Co., Irondale, O., 4 mills.
Washington Steel & Tin Plate Mills, Washington, Pa., 4 mills.

Number of companies purchased from, 39; number of plants purchased, 40; number of mills, 287. Annual capacity about 8,000,000 boxes of tin and terne plates.

NATIONAL STEEL CO.

Constituent companies: Ohio Steel Co., Youngstown, O., Shenango Valley Steel Co., New Castle, Pa., Buhl Steel Co., Sharon, Pa.; Bellaire Steel Co., Bellaire, O.; Aetna-Standard Iron & Steel Co., Bridgeport, O.; King, Gilbert & Warner Co., Columbus, O. All above have blast furnaces and steel works. The latter are all Bessemer plants except the Buhl, which produces basic open-hearth steel. In addition to these plants the National Steel Co. has purchased Thomas Furnace at Niles, O., Rosena Furnace, at New Castle, Pa., and holds under lease the Columbia Iron & Steel Works of Uniontown, Pa. The Union Iron & Steel Co., of Youngstown, O., with bar, hoop and band and cotton tie mills at Youngstown, O., and mills at Girard and Warren, O., was originally included in the National Steel Co., but was transferred to the recently formed American Steel Hoop Co. The National Steel Co.'s interest in iron mines is confined to one-fourth of the Biwabik property on the Mesabi; but it has a 10-year contract for Adams ore (also Mesabi) and a 20-year contract for the Oliver one-sixth of the ores of the Oliver Iron Mining Co.—these giving it an estimated supply of its own of about 1,100,000 tons. Its blast furnaces have an annual capacity of about 1,500,000 tons; its steel works, a capacity of 1,600,000 to 1,800,000 tons, including sheets, bars, and other material from Aetna-Standard finishing mills. The company has a limestone property, and has acquired the Revere tract of 1,132 acres of coking coal lands near Uniontown, in the heart of the Connellsville region. Within the past week it has bought 717 acres additional of coal lands near Uniontown.

Capital stock issued, $26,000,000 of 7 per cent cumulative preferred and $32,000,000 of common, leaving $1,000,000 of preferred yet to be issued. Bonded indebtedness, $2,561,000 distributed as follows: Ohio Steel Co., $1,000,000; the Shenango Valley Steel Co., $330,000; King, Gilbert & Warner Co., $130,000; Aetna Standard Iron & Steel Co., $600,000; Bellaire Steel Co., $301,000; Buhl Steel Co., $200,000. Total interest charge on above, $153,660 a year.

Main offices, Marquette Bldg., Chicago. Officers: President, Wm. E. Reis; 1st vice-president, Henry Wick; 2d vice-president, R. M. Gilbert; secretary and auditor, William H. Baldwin; treasurer, Frederick S. Wheeler. Executive committee—Chairman, Henry Wick; William E. Reis, R. M. Gilbert, Daniel G. Reid, William B. Leeds, Frederick S. Wheeler, William H. Moore. Directors.—William E. Reis, Henry Wick, William H. Moore, William B. Leeds, Daniel G. Reid, James H. Moore, R. M. Gilbert, James McLean, Warner Arms, J. R. McCortney, Frederick S. Wheeler, Myron C. Wick, William T. Graham, John A. Topping, James B. Dill.

THE AMERICAN STEEL HOOP CO.

This company, one of the more recent of the iron trade consolidations, was formed by the amalgamation of the following companies: Isabella Furnace Co., J. Painter & Sons Co., Lindsay & McCutcheon, and Wm. Clark Sons Co., all of Pittsburg; Monessen Steel Co., Monessen, Pa.; Portage Iron Co., Ltd., Duncansville, Pa., (puddling, rolling mill and hoop departments); P. L. Kimberly & Co., Sharon, Pa.; Pomeroy Iron & Steel Co., Pomeroy, O.; Union Iron & Steel Co., Youngstown, O. Annual product about 400,000 tons of hoops, bands and cotton ties, bars, skelp, etc.

Capital stock issued, $14,000,000 7 per cent preferred and $19,000,000 common. Officers: President, Chas. S. Guthrie; 1st vice-president, C. A. Painter; treasurer, F. S. Wheeler; secretary, F. L. Clark. Directors.—C. S. Guthrie, C. A. Painter, Geo. E. Painter, Veryl Preston, W. E. Taylor, R. M. Gilbert, W. T. Graham, F. S. Wheeler, D. G. Reid, W. E. Reis, Henry Wick, J. H. Moore, W. H. Moore, W. B. Leeds, J. J. Treacy.

REPUBLIC IRON AND STEEL CO.

The final organization of the above company is expected to be accomplished within the present week. The company has been incorporated under New Jersey laws, with a capital of $55,000,000, of which $25,000,000 is 7 per cent preferred and $30,000,000 common stock. The estimated yearly product is 1,000,000 tons of iron and steel bars and shapes, plates and sheets, spikes, bolts, etc., in addition to 250,000 to 300,000 tons of pig iron, heretofore marketed as such. In 1898 more than 75 per cent of the finished product was iron. The mining property to be acquired includes the Franklin group on the Mesabi range, consisting of the Franklin, Victoria and Bessemer; and the Lillie and Cambria mines on the Marquette range. The companies whose properties have been acquired are the following:

The Andrews Bros. Co., Youngstown, O.
The Brown-Bonnell Iron Co., Youngstown, O.
The Mahoning Valley Iron Co., Youngstown, O.
Cherry Valley Iron Works, Leetonia, O.
Atlantic Iron & Steel Co., New Castle, Pa.
Lake Erie Iron Co., Cleveland, O.
Union Rolling Mill Co., Cleveland, O.
Corns Iron & Steel Co., Massilon, O.
Toledo Rolling Mill Co., Toledo, O.
Mitchell, Tranter & Co., Cincinnati, O.
Eagle Iron & Steel Co., Ironton, O.
Indiana Iron Co., Muncie, Ind.
Muncie Iron & Steel Co., Muncie, Ind.
White River Mills.
Union Steel Co., Alexandria, Ind.
Marion Steel & Iron Co., Marion, Ind.
Westerman-Stewart Iron Co., Marion, Ind.
Wetherald Rolling Mill Co., Franklin, Ind.
Indiana Forge & Rolling Mill Co. New Albany, Ind.
Central Iron & Steel Co., Brazil, Ind.
Wabash Iron Co., Terre Haute, Ind.
Terre Haute Iron & Steel Co., Terre Haute, Ind.
Tudor Iron Works, East St. Louis, Ill.
Peoria Steel & Iron Works, Peoria, Ill.
Springfield Iron Co., Springfield, Ill.
Inland Steel & Forge Co., Chicago Heights, Ill.
Sylvan Steel Co., Moline, Ill.
Williams Rolling Mill, Muscatine, Ia.
Minnesota Iron & Steel Co., Minneapolis, Minn.
Birmingham Rolling Mill Co., Birmingham, Ala.
Alabama Rolling Mill Co., Gate City, Ala.
Pioneer Mining & Mfg. Co., Birmingham, Ala.
Cambria Mining Co., Lake Superior.
Lillie Mining Co., Lake Superior.
Franklin Iron Mining Co., Lake Superior.
Connellsville Coke Co., Connellsville, Pa
Croton Lime Co., New Castle, Pa.

UNITED STATES CAST IRON PIPE & FOUNDRY CO.

The above company controls about 75 per cent of the cast iron pipe output of the country, its plants having a yearly capacity of about 450,000 tons. The capital stock issued is $12,000,000 of 7 per cent non-cumulative preferred and $12,000,000 common, $3,000,000 of each remaining in the treasury. General offices have been established at 632-638 The Rookery, Chicago. Officers: A. C. Overholt, president; A. F. Callahan, vice-president; B. F. Haughton, secretary and treasurer. Directors.—Samuel Thomas, Colgate Hoyt, A. C. Overholt, W. C. Overholt, A. K. McNeal, George B. Hayes, C. E. Burke, E. C. Fuller, W. C. Proctor, B. F. Haughton, Geo. J. Long, A. F. Callahan, F. C. Miller. The following companies are included:

Dennis Long & Co., Louisville, Ky.
American Pipe & Foundry Co., Chattanooga, Tenn.
Addyston Pipe & Steel Co., Cincinnati, O.
Ohio Pipe Co., Columbus, O.
Lake Shore Foundry, Cleveland, O.
Buffalo Cast Iron Pipe Co., Buffalo, N. Y.
National Pipe & Foundry Co., Scottdale, Pa.
McNeal Pipe & Foundry Co., Burlington, N. J.
West Superior Iron & Steel Co., West Superior, Wis.

THIRD SERIES OF A. F. A. TESTS.

Set C, the third of the series of tests made by the American Foundrymen's Association committee on testing cast iron, was made with iron suitable for light machinery. The composition was as follows: Total carbon, 3.84 per cent, graphite, 3.52, silicon 2.04, manganese .39, phosphorus, .578 and sulphur .044. The set was cast by Messrs. Joseph S. McDonald and Benj. D. Fuller, and through the kindness of the Westinghouse Electric & Mfg. Co., presented to the committee in the interest of the trade. The 193 bars, cast under the same conditions as the first two sets already published, and all of which proved serviceable, furnished 281 separate tests.

From the fractures it appeared that the tendency to pipe is very strongly marked, the heaviest sections in some cases having fully developed pipes, the encircling walls being composed of white segregated (probably high phosphorus) material. The fluidity strips ran up full.

Cast C illustrates a class of castings which must be made with metal fluid enough to run into very thin sections and yet be soft enough to machine readily. A good transverse and tensile strength is essential. About 40 per cent scrap is carried in the mixture. Lack of space compels us to give only a summary of one series of this set.

COMPRESSIVE TEST.

This series of tests is the most interesting of the set. Half-inch cubes were cut from the dry sand square bars and tested as explained in the sets already published. In taking these cubes from the middle portions of all the sizes made, that is from the ½-inch to 4 inch bars, the compressive strengths ran as follows: 38,500, 24,890, 20,750, 18,010, 17,840, 15,950, 15,880, and 14,220 lbs. This shows how much the size of the specimen has to do with its strength when under test.

The foundrymen attending the coming convention in Pittsburg will have an opportunity to see the fractures of all the sizes, both round and square, dry sand and green sand, for the three sets made so far. The specimens were carefully mounted in cases and will form the exhibit of the committee. The work of the committee will continue through the coming year, and a final report will be made at the convention of 1900.

American Foundrymen's Association at Pittsburg, Pa.

The fourth annual convention of the American Foundrymen's Association will hold its sessions in Pittsburg Tuesday, Wednesday, Thursday and Friday, May 16-19. Preparations have been under way for several months, in charge of the

C. S. BELL, HILLSBORO, O., PRESIDENT OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION.

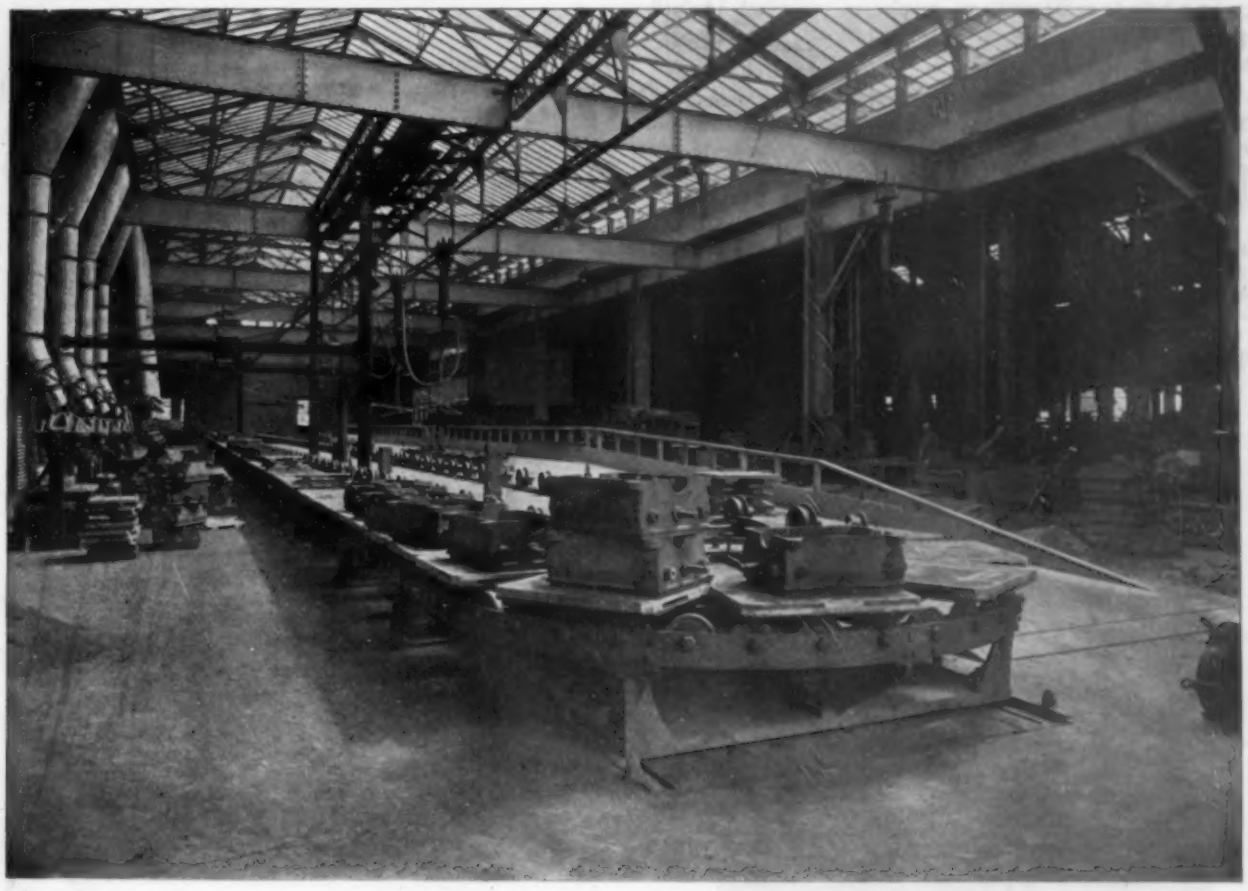
local foundrymen's association's committee and the secretary of the American Foundrymen's Association, with the result that both in the character of the entertainment to be given the guests and in the interest and value of the program, the meeting will take a high place in the association's convention history. The Pittsburg district contains some of the country's pre-eminent industries in various lines of iron and steel manufacture, and not a few of these are of particular significance and interest to foundrymen.

Already there are indications that the attendance will be large. Parties are being organized in the various foundry centers. The New England delegation will leave Boston and other points on Sunday evening, May 14. The meeting place will be Jersey City and on Monday morning the Pennsylvania Railroad train leaves Jersey City at 8:13, reaching Pittsburg at 7:10 p. m. The Pennsylvania Railroad and its New England connections have made a rate of one fare going and one-third fare returning, on the certificate plan. The New England delegation will be a large one. Returning it will probably leave Pittsburg Friday night, May 19, at 10, reaching New York Saturday, May 20, at 8:15 a. m. Here the party divides, the Boston members taking the Fall River boat, at 5:30 p. m., and the others going on by rail. B. M. Shaw, of the Walker & Pratt Mfg. Co., is chairman of the delegation.

C. J. Wolff, of the L. Wolff Mfg. Co., Chicago, chairman of the committee on transportation from that district, has designated the 5:30 p. m. train on the Pennsylvania line, May 15, as the Chicago train. All wishing to go should notify H. R. Dering, A. G. P. A., Chicago, No. 248 Clark st., three or four days before the date of departure. The Cincinnati contingent expects to start Monday evening arriving in Pittsburg at 6 a. m., Tuesday. Cleveland foundrymen recently appointed a committee which has selected Pennsylvania Railroad train No. 342, leaving Cleveland at 11:10 p. m., May 15, and reaching Pittsburg at 6:40 a. m., Tuesday.

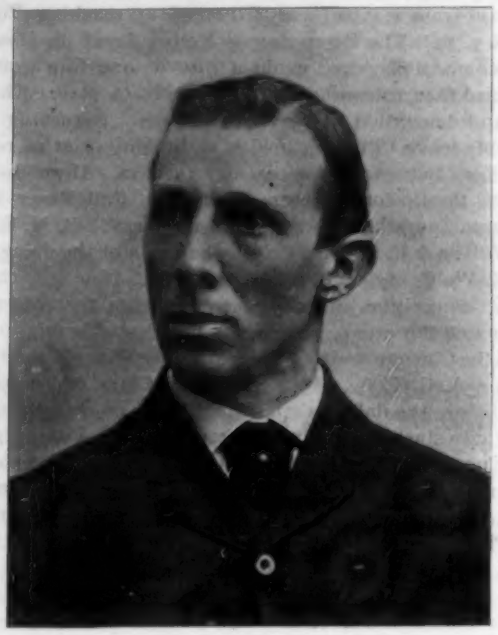
The Programme.

The Monongahela House has been selected as headquarters, and the sessions for business and the reading of papers will be held in the assembly room. The local executive committee, appointed by the Pittsburg Foundrymen's Association, consists of Wm. Yagle, chairman; J. S. Seaman, treasurer, and F. H. Zimmers, secretary. The chairmen of the various sub-committees are the following: Finance, J. S. Seaman; Reception, E. A. Kebler; Entertainment, Isaac W. Frank; Transportation, F. H. Zimmers; Excursion, S. D. Sleeth; Printing and Badges, Robert Taylor; Refreshment, Philip Mathes; Exhibition, Dr. Richard Moldenke; Press, Dr. Wm. B. Phillips.



WESTINGHOUSE AIR BRAKE CO.'S FOUNDRY, TO BE VISITED BY A. F. A. DELEGATES.—VIEW SHOWING TABLES CARRYING MOLDS TO CUPOLA.

The Pittsburg meeting is of interest for two reports that will be presented: One by the committee headed by Dr. Richard Moldenke, of Pittsburg, on a system of bars for the testing of cast iron, with particular reference to the form and method



WM. YAGLE, PRESIDENT PITTSBURG FOUNDRYMEN'S ASSOCIATION.

of casting such bars; the other by Thos. D. West's committee on the preparation and distribution of standardized drillings, as a help to more uniform results in chemical analysis of pig iron. The complete program, as officially announced in the past week, is as follows:

TUESDAY, MAY 16.

The day will be given to the reception and registration of delegates; the locating of visitors at their hotels, and the opening sessions of the convention. An address of welcome will be delivered by Mayor W. J. Diehl, representing the city of Pittsburg. Clarence Burleigh will welcome the visitors on behalf of the local foundrymen, followed by a welcome on behalf of Pittsburg business men, by John Bindley, president Pittsburg Chamber of Commerce. These will be responded to by the president of the association, C. S. Bell. The regular business of the convention, prefaced by reports of the officers will then be proceeded with. The committee appointed at the last meeting in Cincinnati, to establish and

F. H. ZIMMERS, SECRETARY.

supply an agency for standardized drillings will then make its report. The committee consists of Thomas D. West, chairman, Dr. R. G. G. Moldenke, James Scott, P. W. Gates, E. H. Putnam, and they have been actively at work for the entire year investigating and experimenting on a large scale. The test bar committee, of which Dr. Moldenke is chairman, will make a report of progress.

In the afternoon it has been arranged to entertain all visitors with a trolley ride to Schenley and Highland parks.

The convention will reassemble at 8 p. m., and listen to two papers illustrated with stereopticon views prepared expressly for the occasion: "A New England Foundry," a paper by Mr. A. W. Walker, illustrating the new works of the Walker-Pratt Mfg. Co., at Boston, Mass. A paper by Mr. W. J. Keep, entitled "Original methods of Handling Materials at the

PHILIP MATHES, TREASURER.

Works of the Michigan Stove Co., Detroit, Mich." Discussion of the papers.

WEDNESDAY, MAY 17.

A paper by Albert W. Smith, entitled "The Utility of chemically Standardized Iron Samples." Discussion. A

ISAAC W. FRANK, MEMBER EXECUTIVE COMMITTEE.

paper by James Powell, entitled "The History and Technique of Brass Founding." Discussion. A paper entitled "The Importance of Fillets and Round Corners in Modern Machine Castings," by John M. Richardson. Discussion.

A special train will be provided in the afternoon and those attending the convention will be taken to Wilmerding and given an opportunity to inspect the foundry of the Westinghouse Air Brake Co.

An evening reception will be given those in attendance upon the convention and their friends, at the Hotel Schenley, to which the ladies are especially invited.

THURSDAY, MAY 18.

A paper by C. J. Wolff, entitled "The Advantages of an Upper Floor Foundry for Light Castings." Discussion. A paper, by Eli Millett, entitled "An Improved Method for Setting up Brass Furnaces." Discussion. A paper, by Thomas D. West, entitled "The Deceptive Fracture of Pig Iron." Discussion.

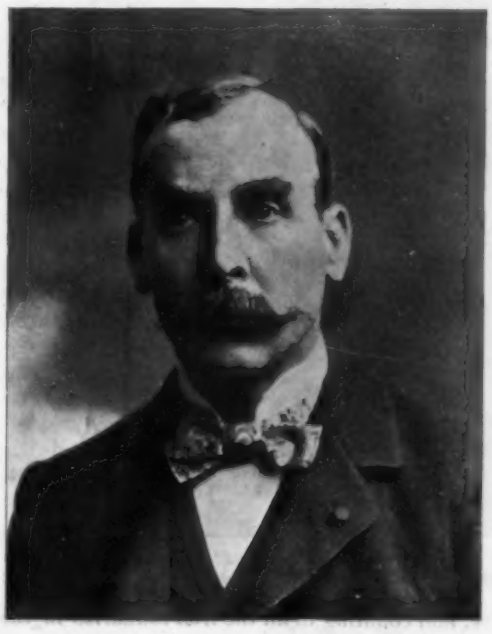
In the afternoon the members of the convention and their friends will go via steamboat to Homestead, Pa., where a full opportunity will be given to inspect the Homestead plant of the Carnegie Steel Co.

J. S. SEAMAN, MEMBER EXECUTIVE COMMITTEE.

On Thursday evening a smoker will be tendered to those in attendance at the convention, at the Monongahela House.

FRIDAY, MAY 19.

This day will be given up to a general entertainment of



ROBERT TAYLOR, MEMBER EXECUTIVE COMMITTEE.

visitors and every opportunity and assistance will be given them to visit local foundries and points of interest.

A committee of ladies has been appointed who will have every arrangement completed for the care of the ladies accompanying those who come to the convention, and who will provide entertainment throughout the entire meeting.

Exhibit of Ornamental Castings.

The exhibition of castings, which will be one of the features of the convention, is expected to exceed in variety and excellence of workmanship anything of the kind that has attended preceding gatherings. The art castings which Secretary Penton has brought from Europe will attract particular attention. Some of these were made in a small interior town near Moscow, in central Russia, far away from civilization or

J. S. MCDONALD, MEMBER EXECUTIVE COMMITTEE.

railroads, and the men who did the work are so unlettered that they can neither read nor write. Another portion of the exhibit is from the Hartz Mountains region in Germany. For the general exhibit, which is in charge of Dr. Moldenke, a number of applications for space have already come in, and the expectation is that the show will be quite creditable. Through the courtesy of Secretary Penton we are able to present a view of one of the Russian art castings, showing a pair of Cossack riders in characteristic mount and attitude. These Russian and German castings have been on exhibition in Detroit in the past week and have attracted much attention both from laymen and practical foundrymen.

The Pittsburg Foundrymen's Association.

Though the youngest of the local foundrymen's associa-

E. A. KEBLER, MEMBER EXECUTIVE COMMITTEE.

tions having monthly meetings, the Pittsburg Foundrymen's Association has shown itself one of the most vigorous of them all. It has distinguished itself for the character of its papers and discussions; and on its initiative the two important lines

of work were started at Cincinnati last year, that are to be reported upon next week, and all credit is due it, as to the Western Foundrymen's Association belongs the credit of formulating the system of apprenticeship adopted by the American Foundrymen's Association at its Detroit meeting in 1897. Pittsburg as an important metallurgical center furnishes a stimulus to effort in these lines unequalled in any other city; and the Pittsburg association has already distinguished itself for its contributions to foundry literature. Its officers, whose portraits we take pleasure in presenting in this issue are the following:

Wm. Yagle, of Wm. Yagle & Co., president; Dr. Richard Moldenke, consulting engineer of the McConway & Torley Co., vice-president; F. H. Zimmers, Union Foundry & Machine Co., secretary; Philip Mathes, Brittan & Mathes Co., treasurer. Executive committee—Isaac W. Frank, Frank Kneeland, Machine Co.; J. S. Seaman, Seaman-Sleeth Co.; Robert Taylor, of Taylor, Wilson & Co., Ltd., Allegheny; J. S. McDonald, Westinghouse Electric & Mfg. Co.'s foundry department; E. A. Kebler, Pittsburg representative of Matthew Addy & Co.

ONE OF THE ART CASTINGS TO BE SHOWN AT THE PITTSBURG CONVENTION. By courtesy of *The Foundry*.

PITTSBURG AS A FOUNDRY CENTER.

The overshadowing effect of Pittsburg's blast furnace, steel making and rolling mill interests usually prevents a proper conception of the importance of the foundry interests of the district centering in that city; but it is a fact that the foundry interests of Pittsburg are sufficient in themselves to make the city famous in the foundry industry. Not only is the tonnage melted an enormous one, but there are several lines of foundry work in which Pittsburg has almost a monopoly. The advantageous position of the Pittsburg district as a foundry centre is shown by the fact that it draws its supply, in addition to what is furnished by the local furnaces, from almost all directions; from Dunbar, in the Connelsville coke region; from Riddlesburg, in the south central part of the state; from the "valleys" to the northwest, and frequently from Alabama. The charcoal iron, which many of the Pittsburg foundries use comes from even a wider range, from Georgia, Alabama, Michigan and Wisconsin.

There are nearly 50 large iron foundries in Allegheny county, and counting in all the iron foundries in the western part of the state, there would be close to 100. Outside of ordinary jobbing work there are a number of foundries in the district which do work from its quality and quantity that places them in the lead in their various lines.

Pipe Balls.

A line of foundry work which is perhaps done only in the Pittsburg district is the manufacture of "pipe balls." These have the shape of a sphere with a cone projecting at one side, and are used in the manufacture of welded pipe, the pipe passing round the ball, which is used as an anvil in the welding. The utmost accuracy is required in the manufacture of pipe balls, which must be of the exact size and shape

desired, requiring accurate molds, and careful mixing to produce uniform shrinkage.

Chill and Sand Rolls.

There is probably no line of heavy foundry work requiring more skill than the manufacture of the large chilled rolls. Such rolls were originally used for little else then the rolling of light sheets for sheet iron, galvanized iron and tin plate, but as they were made stronger and better it was possible without too great expense to use them for a number of other purposes. It was due to the inventive capacity and business insight of the gentleman who is usually called the Dean of the Pittsburg Foundrymen's Association that chill rolls were introduced in the rolling of rails, the hard surface greatly reducing the wear of the part coming in contact with the web of the rail, so that the tonnage rolled without re turning can be greatly increased. The chill roll business is centered in the Pittsburg district, where there are nine large foundries making chill rolls for the general trade. There are but four of any consequence outside of the district. The small chill rolls used for cold rolling steel strips, and for rolling the softer metals, in the East and in New England, are made to a limited extent in New England, but even for this branch the Pittsburg founders make a great many rolls. The very best charcoal irons, cold and warm blast, are required in the manufacture of chill rolls, and the most caref l mixing and casting. A novice essaying to make these rolls would frequently turn out rolls which would break when cold, of their own internal strains, yet the good rolls stand great changes in temperature in use, and heavy mechanical strains. The district produces not far from 3,000 chill rolls a year, worth $250 a piece for the medium sizes. The sand roll tonnage is also very large. While sand rolls are used in a greater variety of work than chill rolls, their life is usually longer, and while a good sand roll is, from an outside standpoint, a decidedly difficult casting, the work is not nearly so hard as the making of chill rolls.

Rolling Mill Machinery.

In rolling mill machinery Pittsburg enjoys the same precedence that it does in chill and sand rolls. All but three of the chill roll foundries make heavy rolling mill machinery also, while there are quite a number of large foundries making mill machinery which do not make rolls. The bulk of the rolling mill machinery used in the United States is made in Pittsburg. In fine hydraulic machinery for tables, etc., an important quantity has been exported, especially to Russia. The tonnage involved in such machinery is something enormous. Large shears for cutting steel in rolling mills weigh as much as 50 tons. Housings for sheet and tin mills are cast in one piece and weigh 11 or 12 tons apiece, and a great many of these are made in Pittsburg. An order turned out last year in one of the large foundries consisted of 114 housings, or about 1,200 tons in a single order. The housings for large blooming mills weigh still more. Many of such castings are made from the air furnace. There are a number of foundries in the district making rolling mill machinery which have capacities ranging from 75 to 100 tons and over a day, a large proportion of the capacity being in air furnaces.

While Pittsburg does very little in the manufacture of the ordinary types of lathes, there is a large trade in roll turning lathes, which have a construction of their own. The largest size of such lathes will swing a roll 60 inches in diameter, a size somewhat larger than the largest rolls used in plate or blooming mills. A lathe of that size weighs about 80,000 pounds. While all this rolling mill machinery is heavy and massive, it does not follow that the work need not be accurate. For example, the large blooming mills have their rolls driven by pinions, i. e., gears mounted in housings, the lower gear being mounted on the mill shaft which drives the lower roll in the blooming mill, and the upper gear driving the upper roll. It is claimed that such pinions, made of steel, and 34 inches in diameter, with staggered teeth, are made to work with only 1-16 inch back lash. In hydraulic manipulators, tables, etc., the work is required to be very accurate.

Engines.

It is a fact not generally credited that from Pittsburg have come some of the largest and best mill engines used in the country. There are three concerns making large engines for heavy rolling mill work, reversing blooming mill engines, automatic engines, and even Corliss engines are made. In the blowing engines no showing is made, but plans are now well under way by one of Pittsburg's foremost interests, for a complete plant making blowing engines as well as other engines, of all sizes, required in pig iron and steel manufacture and rolling mill work. The result will be, no doubt, that in a short time perhaps the bulk of this heavy engine work will come to Pittsburg, where it belongs. There are a number of foundry and machine shops making engines for miscellaneous use, while the manufacture of quick-revolution engines for electric work has been a leading industry for years. There are two large concerns making locomotive engines, their specialty being lighter engines for mines, steel works, etc.

Air Brakes, Car Couplers and Car Wheels.

Pittsburg always gets the credit for being the center of the air brake industry. The tonnage melted at the works of the Wilmerding is very large, and the work is of a character requiring the highest skill of the molder and founder. In the manufacture of car couplers is found the only important malleable iron work done in the district; but the car coupler works in Pittsburg stands for a great many ordinary sized malleable iron founrdies. There are two car wheel foundries in Pittsburg, one of which was erected only last year.

Stoves.

Pittsburg was once the center of the stove industry in the United States. Newer sections have entered the field, and while Pittsburg has grown slowly, they have grown rapidly. Still the tonnage in stoves is a very important one, and there are eight large stove foundries in Western Pennsylvania, one being at New Castle, another at Monongahela City, and the others nearer Pittsburg.

Miscellaneous.

Of course, in a district having such facilities as are found around Pittsburg, a great deal of miscellaneous foundry work is done, and of this there is no occasion to make mention, because the work is not peculiar or characteristic of the region. But there are a number of miscellaneous lines produced in Pittsburg which are made only in a few other places in the country. Thus, some Pittsburg foundries and machine shops have done considerable work for the government in the way of castings, etc., for gun carriages. Some very large gears are made, both cut and machine molded. There are two large gear cutting establishments. One of these can cut bevel gears 8 feet in diameter and 24 inches face, and spur gears still larger. One concern which now makes machine molded gears is about to erect a large plant for this purpose, and will make very large and heavy gears, with machine molded teeth.

The bath tub industry is a very important one in the Pittsburg district, what is probably the largest plant of this kind in the world being located there. The casting of a bath tub is a very delicate piece of work, on account of the shape and the thinness of the casting, and requires a great deal of experience and skill.

A very heavy tonnage of ingot molds is cast in the district, but this class of work is of little interest to the general founder, as the work is not at all intricate. One large plant is run in connection with the leading steel interest, which casts the molds for its own use in the steel works, direct from the blast furnaces.

At the present time three steel casting plants are being built or are projected in the district, all of which will be equipped with acid open-hearth furnaces.

The Lidgerwood Mfg. Co., 96 Liberty st., New York, makes the statement that it is the owner of some 60 patents on hoisting and conveying devices, especially cableways, and that every form of rope support or fall rope carrier is covered by the parent patents it controls. The company adds: "We have expended thousands of dollars in the development of improved devices now found upon the standard Lidgwood cableway and shall protect ourselves against any infringements of any of our patents, whether they form a part of our present cableway or may be substituted therefore."

Machinery Agencies vs. Direct Selling.

Some weeks ago *The Iron Trade Review* referred editorially to one indication of centralization in the trade in machine tools—the announcement by a well known firm of machinery dealers, of exclusive representation, in Chicago and the Northwest, of a number of tool-building concerns. It was said, by way of comment, that if this arrangement were duplicated in other districts, there might come at length such a concentration of the selling side of the machinery business it would tend to a divorce of manufacturing and selling; that thus the manufacturer would hear of the needs of the trade through the selling agency and in time would be practically cut off from communication with the users of his tools.

Our correspondent "Scrutator" in characteristically vigorous and direct English, excepted to the suggestion, and in two or three communications cited instances and gave reasons, which, to his mind, were sufficient evidence that the machinery business would not follow the lead toward consolidation, that other industries were then and are still setting at so fast a face. Some of his observations were in these terms:

"There is a difference between manufacturing machinery and manufacturing gum drops, as 'Chordal' would say, and there is also a difference between selling machinery and selling gum drops. I have said before that 'brains cannot be cornered,' and this is the key to the situation; and therefore it is not a surprise that the 'machinery business has maintained for so many years such a numerous and diversified array of individual producers.' If the machinery business ever gets into the socialism of the present, it will be the last to go in, and the very first to take the lead in the individualism of the future. It is inherently individualistic; it is the exact opposite of the gum drop business.

"In the very nature of things I must know more about my own machine than any agent who is trying to sell a 'complete shop equipment' can possibly know. One man, no matter how capable, cannot know all the points regarding 20 or 30 distinct classes of machinery, and as this is an age of specialties, I am still of the opinion that the making and selling of machinery will not be 'divorced' as the editor of this paper calls it—that is, not in the long run.

"The man that can make good machinery is never satisfied to let some one else sell it, and what is more, never will be. It is not in human nature that he should be. The instant that a man loses his personal interest and responsibility in any scheme, he would, generally speaking, better sell his stock and go a-fishing. And the signs are not wanting of lots of examples of this eternal truth, to be seen without an opera glass, in the near future."

To get an expression on the subject from the machinery trade—both the manufacturing and the purely selling factors in it—we addressed letters to a number of firms recently asking for their comment upon the views of "Scrutator" as indicated in the above quotations. Some of the replies are appended There is some divergence of opinion, the expressions representing in many cases the practice of the writers. In general selling by agencies, particularly of standard types of machines, is regarded as advantageous, and a number of manufacturers acknowledge their obligation to the dealers, who, by carrying a variety of lines, are able to do an extensive business and in many cases to sell complete equipments. Concerning special machines, the expressions of our correspondents vary; but here, in the minds of not a few, the line is to be drawn, this being the field in which the manufacturer can operate independently to the best advantage. We have no doubt the entire correspondence will be read with interest by every manufacturer and seller of machinery:

Deal Directly with Buyer.

The Bullard Machine Tool Co., Bridgeport, Conn., writes as follows:

"In our judgment, there are cases where manufacturer and dealer can work together to mutual advantage and each manufacturer must judge for himself as to the best method of doing his own business, i. e., the direct or indirect. The manufacturer who aims to reach a high standard of excellence both in design and workmanship, will, in our judgment, which is based upon a somewhat extended experience, find scant encouragement, as a rule, on the part of dealers, who naturally are more concerned with the matter of price than of quality, provided the quality is good enough to pass muster. Our plan is to deal directly with our customer, but we make exception when we find it desirable to do so, particularly in the matter of fields distant from our works."

Dealer Must Have Large Equipment.

A Western firm of machinery manufacturers presents this view:

"In reply to your favor relating to a greater separation of machine tool manufacturers from the consumer by the intervention of a selling agent, we may say briefly that as a rule we would not deem the adoption of such a system generally beneficial, either to the manufacturer or to the consumer. But, there may be exceptions to such a rule, and it is possible that the exceptions might become the rule. If the intervening dealer is so qualified and equipped that he will take charge of the inventions, the designing, the patent business, etc., now conducted wholly by the manufacturer, so that the manufacturer has nothing to do but to make machines according to designs and specifications of the dealer, we see no reason why it should not work well enough to have the manufacturer confine himself wholly to construction. But the intervening dealer must be a designer, and contract for his machines for such prices and in such quantities as to induce the manufacturer to confine himself solely to shop work. Most of our machine shops are the growth of planting and cultivation through the genious and energy of their proprietors. Such men, under the new system, would become the dealers, and leave to those who may be excellent men, but not originators, the conducting of the shops. As for ourselves, if some intervening responsible dealer would contract with us for about as much as our shops can produce for a series of years, for prices that we deem adequate, we should have no objection to making a contract with such a dealer; he to take all of our shop output. But we would not like to surrender our trade name, or our intercourse with our customers under any other conditions.

Agency Selling with Proper Provisos.

The Jones & Lamson Machine Co., of Springfield, Vt., sees that the question is by no means one-sided:

"Since every one is more or less biased by the conditions under which he is working, we will begin by saying that we sell direct to users and do not sell through or allow brokerage or commission to any one in America. We build the flat turret lathe in one size only, and with the exception of the tools used in the machine, we make nothing else. There is no reason why good results cannot be obtained from properly organized machinery selling agencies, provided there is loyalty of manufacturer to agent and vice versa.

There are many machines like plain, good old reliable lathes, made on honor and for a low price that cannot be sold direct as well as through agencies, but all departures from the standard types require special pushing, either by specialist

attached to agency or by the manufacturer. The agent should be given a commission on everything sold in his territory, whether sold by manufacturer or agent. Each salesman for the agency should push some specialty, at the same time be able to sell intelligently any of the standard machines. The manufacturer should know that the agent is not handling any conflicting machine, or the manufacturer should know that he is allowing a much larger commission than his competitors so that his machine will be the most profitable to the agent.

"And last but not least, the manufacturer should know that the agent's financial standing is at least as good as the user to whom he would sell if not to the agent. If the foregoing conditions are not obtainable, direct selling is the surest, safest and best in our opinion."

Dealer and Manufacturer Work Together.

For the Cincinnati Machine Tool Co., A. H. Tuechter replies as follows:

"It is a difficult matter to reply to your question in general terms, but taking the writer's experience as a basis, we feel that the two departments, manufacturing and selling, are separate and distinct. Naturally the manufacturer of a machine tool knows more about his specialty, its construction, and the details connected with it, than he can ever expect the dealer to know; and to a mechanical buyer, he can present these matters with much greater force than the dealer. At the same time the manufacturer in these days must devote nearly all his time to the manufacturing end, and has comparatively little time to get around and sell the goods.

"The plan which the writer has adopted is to let the dealer start up the customer. We then assist in whatever way possible from this end, by writing letters of explanation, or even going to see the customer together with the dealer; and we have found this plan to bring us the best results. Furthermore it has reached the point where the dealers travel, and systematically work their respecitve terirtory at intervals; and there is no section of a good manufacturing country that is not thoroughly canvassed in this way. It is only natural, therefore, that the dealer not only should have credit, but recompense for his work. Taking it all in all, we feel that it is impossible at the present time for any manufacturer of machine tools, unless he would buil dan absolutely complete line, to sell his product in this country and abroad, and achieve the right results, without the dealer; and the manufacturer must assist and work with the dealer at all times."

Largely in the Hands of Selling Agencies.

Mr. C. A. Clarke, of Hill, Clarke & Co., Boston and Chicago, makes these observations as the result of a broad experience:

"During our experience of about 30 years in the machinery business, as machinery merchants and agents, we have found that the development has been more and more toward the sale of machinery by agents and merchants. Being one of the oldest firms of machinery merchants in the country our first experience was that very few manufacturers would recognize agents or dealers, and tried to market their entire product direct. To-day, with only one or two exceptions, all machinery manufacturers are placing their products in the hands of agents and merchants, and in nearly all cases the merchant has exclusive control of a specified territory. This not only applies to the regular standard goods which are sold very much the same as hardware, but it also applies to new and special inventions which require a great deal of explanation and missionary work, and on account of having in our own business so much special machinery to sell, we have found it necessary to employ a large corps of practical mechanics and mechanical engineers who make a specialty of new inventions.

"Some writers on this subject of machinery dealers have taken the ground that the larger part of the machinery dealers of the country simply take orders for machinery without knowing anything about the machines they sell beyond some specified dimensions and the price; but we have found it necessary to have a corps of salesmen who can thoroughly explain the machines they sell and also who are competent to recommend special machinery for special work. This applies particularly to our Chicago store where we are not in such close touch with the manufacturers as we are here at the Boston office.

"Finally, we would say that one of the most important points in favor of the machinery merchant is the large stock of the various kinds and sizes of machine tools that are carried in store, so that a customer can see what he is going to buy and make a selection."

Close Relation of Manufacturer and Customers Best.

"Die Press," representing a firm manufacturing metal-working machinery, writes:

"We do not build what are generally known as machine tools, and are therefore not in a position to speak on that subject. Our line is the manufacture of presses, dies and special machinery for the production of sheet metal goods of almost all descriptions; and in our opinion, it is practically impossible for the ordinary machinery dealer to understand so fully the requirements of manufacturing miscellaneous sheet metal goods as to handle the business intelligently. In nine cases out of ten the customer does not himself know what is required, and the dealer or manufacturer must take the responsibility of determining the question. The infinite variety of sizes and shapes of articles to be made and kind, quality and thickness of sheet metal to be employed, often taxes the knowledge and experience of practical veterans in the business. The dealer in 99 cases out of 100 would be all at sea. It is only the plain standard machines, comparatively few in number, that can be handled successfully by dealers and then, as a rule, only when the customer has a good idea of what is required. In our judgment the closer the manufacturer and customer come together in this particular line, the better it will be for the interests of both. We do not see how it is possible to concentrate the sale of sheet metal working tools in the hands of one or more dealers. To make the business successful, the customer and manufacturer must come together in nearly all cases."

Direct Selling Generally Best.

From an Eastern manufacturer of machine tools:

"We are concentrating our entire time and efforts to producing machinery at this time, for the demand is so great that we cannot begin to produce as fast as required, and are not worrying ourselves so much about disposing of the product as heretofore. Just at this time, therefore, the question referred to does not appeal to us as strongly as it might have done several years since. We do not believe it is necessary to confine ourselves to machinery agencies, or for the manufacturer to be dependent upon them. We have found it for our interest to deal direct, very largely, and find that this, as far as we can learn, is desired by the buyer. As a producer of machinery we find that our direct intercourse with the seller is appreciated, naturally being fully familiar with the different points of design, etc., on which the machinery agents would not be posted."

The Dealer's Wider View Valuable.

John Rahn, Jr., president of Rahn & Mayer, Cincinnati, speaks well of his experience with dealers:

"The writer's personal view upon this matter is that the manufacturers of machinery and the machinery agencies are becoming more and more closely tied together to their mutual interests; one in manufacturing the product, and the other in successfully disposing of the same. Manufacturers of machinery are gradually going into specialties, instead of a general line of machinery, and have therefore but one article to sell; whereas the dealers carry a full line of machinery. Hence, in meeting with the consumer, they can place before him a full line of machinery from which to choose, giving him an advantage over the manufacturer, whose interest is to show but a specialty.

"I also believe, that a live machinery dealer is better able to advise the consumer as to just what machine he needs for his work, from the very fact that he is better acquainted wtih the different classes of machinery with which he is continually coming in contact.

"It is, however, essential for the manufacturer to keep his name before the trade in general, through judicious advertising, even though he does not care to solicit the orders

directly from the consumer. This can be done by working jointly with the dealer, by referring the trade to the agencies who are handling this product in the different parts of the country, where it is sold. We ourselves have founded our business upon the principle that it is better to have the dealer handle our lathes, instead of hunting up the consumer, and find that we have built up our business successfully, at a much lower cost, than we could have done in trying to secure the trade without the agencies."

Viewed from a Dual Standpoint.

The W. P. Davis Co., of Rochester, N. Y., speak as dealers and as manufacturers:

"We are in a very good position to know, as we not only manufacture, but also keep a large machinery store, and sell all classes of general machinery, such as machine tools, engines, boilers, and supplies. We believe that the machinery agencies are of great assistance to the manufacturers where goods are made with the maker's name cast on the machine and are sold as such; but we think in many cases where tools are made and sold by the dealer as his own make, that it often leads to a dissatisfaction both ways.

"In the first place, many of these tools are not made first-class; the general appearance of the machines is perhaps good, and in cases they are finely polished and painted, but the real value in a machine tool is in the accuracy and the fitting, which do not show without the machine is taken apart and carefully tested in various ways.

"When the manufacturer puts his own name on the tools, it is a guarantee to the buyer that the manufacturer has his reputation back of the tool And in case the tool is defective, all fair manufacturers are only too glad to correct such defects; and all manufacturers we think should protect their selling agents to a reasonable extent in whatever locality they are situated. The writer has been manufacturing for the past 25 years, and as a whole we have only kind words to speak for the machinery dealers, as they have assisted us in selling thousands of dollars worth of goods that otherwise we could not have disposed of. And in all cases where we have people handling our goods in the different cities we always protect them if we know they are talking and pushing our goods; even though they may not always carry them in stock.

"We believe our views are true in selling special machinery. Standard tools like lathes and drills are often ordered direct, although as a general thing on tools of this class, the dealer by buying them in large quantities can sell them as close as the manufacturer would care to sell them at retail."

Let the Dealer Do the Selling.

A Central Western machine tool company explains its practice thus:

"You have opened up an exceedingly big question. It is the policy of this company to foster the dealer and have a less number of names on our books to whom we give credit, and let the dealer do the selling. The difficult feature of this shows up plainly in these times, namely; a flood of orders reaches us from all dealers at about the same time, causing our product to be oversold, perhaps six months This same state of affairs occurs all over the country. The price of material goes up and the price of labor goes up; the goods are bought by the dealer, sold by ourselves based on former low prices, and right while they are in course of construction, we are obliged to pay more for labor and material and pocket a severe loss, just at the time we should be making considerable money. This you will see quite clearly is a hardship. On the other hand, were we to refuse to fill the orders, we should place the dealer in a bad position with his customer. We are endeavoring to straighten matters out by laying the facts before our various agents and endeavoring to reach an understanding whereby all prices from this date on shall be quoted with a view to the market in labor and material and as we make it a point to remain good friends with our agents, think that an amicable understanding will be reached."

No Reason for Changing the Old Way.

The Acme Machinery Co., Cleveland, manufacturer of bolt, nut and special machinery, writes:

"Our experience, covering a good many years, is that we can sell goods both direct and through machinery dealers, without any more clashing of interests than arises in the ordinary course of any business. The world is pretty old, and in order to do business, men have always had to 'give' as well as 'take.' Perhaps we have arrived at the point where it is going to be all 'take' and no 'give,' but we do not believe it, unless the bottom has fallen out of the 'nature of things.' We propose to continue to make the very best machinery we know how to make and we do not believe we shall find any difficulty in finding some route to get it to the people who want it."

Agents do Well Except on Special Machines.

A firm manufacturing a single line of machinery replies as follows:

"We believe that in our line, which consists of special machines, selling direct is the most satisfactory. We send out our own representatives who are able to bring out the good points of our machine and at the same time are able to know whether or not those machines already in use are being used to the best advantage. This is something that an ordinary agent who handles all kinds of tools and is able to furnish a complete machine shop outfit is very seldom able to do. For such tools as lathes, planers, milling machines and perhaps a few other machines with which every mechanic is more or less familiar and able to operate to the best advantage, we believe that the regular machinery agent could do very nearly as well as a salesman direct from the factory, especially if he were a bright man with a fairly good knowledge of machine shop equipment. But when it comes to special machinery the representative ought to be a man who is familiar with every operation and condition existing and be able to suggest to prospective buyers in just what lines and wherein the tools he represents could be used to advantage and in an economical manner."

Should Work Hand-in-Hand.

A New England company finds plenty of room for both interests:

"Our opinion is that the interests of the selling agencies and the manufacturers are quite identical, and that the position of each branch of the business is so thoroughly established that they will continue to work in harmony for many years to come. It seems to us that the manufacturer must continue to create the demand, or his product by making its special advantages clearly known to all respective buyers, and that the selling agency will continue to do a considerable share of the business of installing large plants to specifications which are made up by the buyers. We also think that the custom of direct sales of special machines from the manufacturer to the user, will increase for the smaller transactions covering occasional additions to the plants of buyers."

Selling Agents are Needed as Distributors.

James A. Kelley, manager, says on behalf of the R. A. Kelley Co., Xenia, O.:

"We do not feel that a consolidation or concentration in the selling of machine tools is practicable or desirable. We believe that the jobber of machine tools fills a special place and is needed as a distributor, just as wholesale houses are in other lines of trade. In our own experience, machinery houses bring us many customers which perhaps we would not otherwise secure at all. And they sell them for us at a more economical cost than we could possibly do. On the other hand, we believe it is essential for the manufacturer of tools to preserve his identity. And while the first few years spent in building up a business of this kind may prove to be a hard struggle, and a much more severe task than if the sale were intrusted to a house with a large outlet and abundant capital, we feel on the whole, that the effort and persistent work required on the part of the manufacturer of machine tools in building up a business and a name for himself, will be more than repaid by the returns of after years.

"We do a business with a considerable number of jobbing machine tool houses, and are, and wish to keep, on the most friendly terms with them. They have a distinct place in the selling field, but should not, from our standpoint, monopolize it to the exclusion of the builder of the tools which they handle."

Blast Furnace and Cupola Practice*

With a Discussion on the Use of Casting Machines for Foundry Iron.

BY EDGAR S. COOK, POTTSTOWN, PA.

The increase of the daily product of the modern blast furnace has called the attention of managers to the necessity of improved methods for casting and handling the large tonnage of iron. Not many years ago, all the pig iron made was cast in pig beds, moulded in sand. Even with moderate products, there has always been more or less trouble in securing men to remove the iron from the cast-house. Few men, comparatively, have the physical strength, or having the strength, care to perform this exhausting labor, day after day, Sundays and legal holidays included. Blast furnace work is absolutely continuous. We have no holidays, and if the men to fill certain positions are not on hand, they must be replaced or the furace stopped. Frequent stoppages are costly and disastrous.

The difficulty is not alone with the removal of the iron from the beds. After the iron is tapped from the furnace and distributed into the twenty or thirty beds, each "pig" must be separated from its "sow" and the "sow" running the length of each bed, must be broken into lengths corresponding approximately with that of the pig. This work is usually done when the iron has become sufficiently solid to bear the weight of a man, and not bleed or run when separated. This is hot and exhausting work, especially in the summer months, and not unfrequently is the source of the greatest anxiety to the manager. Many men cannot withstand the burning heat and succumb, thus discouraging others, who are only too ready to avail themselves of any excuse to escape the trying ordeal. The pigs must be separated from the sow and the sow broken, otherwise the iron cannot be removed and the beds molded for succeeding casts—the casts following one another every four or five hours.

Various mechanical appliances have been proposed from time to time, but one objection or another prevented their adoption. Furnaces connected with steel works substituted for the sand beds, iron molds, or chills as they are termed. These chills obviated the necessity of molding in sand, thus economizing in labor and saving time, and thereby increasing the capacity of the cast-house, but their use did not overcome the necessity of breaking the "pigs" from the "sow," etc. The labor of removing the iron from the cast-house also remained the same. With the advent of the basic open-hearth steel furnace, the demand for iron low in silicon and free from surface sand, brought about the introduction of iron chills or molds, by merchant furnaces proposing to make basic iron, that is, iron of a composition to suit the requirements of basic steel manufacture. Many of the casts run into these chills, upon being analyzed, were found not to meet the specifications of the buyer, being too high in silicon, or too high in sulphur. This iron became known as "misfit iron," necessitating its sale for some other purpose. The high sulphur pig was found suitable for puddling, a reduction in price being made to effect a sale, simply because it was "misfit iron." The puddle mills were thus made acquainted with sandless pig iron, and although introduced at some disadvantage, it is now used on the same terms as pig cast in sand. Some mills express a decided preference in favor of the clean iron, free from adhering sand. The misfit basic, high in silicon, found its way to foundries, to be remelted and run into castings. It might or might not have been of a composition to suit their requirements. Whether it was or not, it labored under the disadvantage of being a "misfit iron" and was naturally looked upon with suspicion.

Introduction of Casting Machines.

Casting machines or tables are now replacing the chills in the Bessemer furnaces of large capacity. These tables, when well constructed, are likely to give the relief so long sought for, obviating the necessity for a cast-house and do away with the exhausting and troublesome labor referred to. The furnace is tapped at such intervals as may be found convenient, and the molten iron run into ladles or cars of 20 tons capacity or larger. Each car as filled is then emptied into molds of cast-iron or of stamped steel plate, coated with a wash of clay or lime, the mechanism of the table being so arranged that the molds move slowly in front of the ladle. It is evident that each lot of 20 tons, the ladle serving as a mixer, when poured into molds of the same section and cooled under the same conditions, must be practically uniform, one pig compared with the other. The steel trade, having arrived at an exact knowledge of the kind of pig iron required, is able to specify the analysis wanted. All purchases are made without reference to the accident of fracture. The limitations as to silicon and sulphur, to say nothing of phosphorus are the determining factors. To the best of my information, sandless pig is preferred by Bessemer works to that cast in sand, while for basic steel manuacture, sand pig will not be accepted.

Analysis vs. Guess-Work in the Foundry.

Foundries connected with steel works have been using sandless pig for a great variety of castings with entire satisfaction, the management simply specifying the analysis of the pig required. From time immemorial, the general foundry trade has been judging and determining the comparative values of iron for different purposes, by the fracture, without reference to the chemical composition. The experienced, observing man is able to make, at times, fairly correct guesses as to the quality of an iron, drawing his conclusions from the color of the fractured surface, the size of the crystallization, as well as the face of the pig. Demands on the foundry are now far more exacting than was the case years ago, and the margins of profit much smaller, calling for more exact methods, less guess work, and greater certainty as to the character of the castings.

It has been a matter of the greatest surprise and wonderment to me, upon visiting certain foundries, where the "rule of thumb" held perfect sway to the entire exclusion of any technical knowledge, that the mistakes and errors were not more serious practically and disastrous financially. If I were compelled, however, to make a choice between a practical man, thoroughly well acquainted with foundry work, a man of good judgment, but possessed of no chemical knowledge, and a theorist, equipped with all that technical schools and a course of chemistry can give, but with little or no practical acquaintance with foundry conditions, I would certainly take my chances with the former. There is no reason, however, why the better qualities of both may not be combined in the one man. There is now so much literature on the subject of cast iron as applied to foundry work, that any fairly intelligent man can soon acquire all the chemical knowledge required to assist him in adjusting the mixture of iron, guided by the analyses furnished by an expert chemist, to suit the varying requirements of complicated or simple castings.

The most successful blast furnace managers are those who, by daily contact with furnace operations and close application, mastered the practical details and then supplemented this training by technical studies, to gain a knowledge of the value of the composition of ores, etc., as well as of the slag and iron product.

When I first became acquainted with blast furnace operations, they were conduced entirely on a system of guess work, so far as the material filled into the furnace was concerned. Analyses of slag or of the iron produced were seldom or never made. If anything went wrong, causing irregular work and reduced product of iron, with consequent increased cost, the blame was invariably placed upon the ore or coal. It was so much easier and satisfying to place the responsibility for one's own mistakes and errors upon the party supplying the raw material. As long as this system prevailed, there was no chance of any improvement. The modern blast furnace became a possibility only with more intelligent management, the management that without neglecting the teachings of practical experience, availed itself of all the help afforded by chemistry, to unfold a knowledge of the composition of the material used, the value of the various elements in their numerous combinations, as well as the composition of the iron produced. The data thus acquired by blast furnace managers as to the quality of various grades of pig iron, the influence of silicon and sulphur, etc., have been of more or less value to foundries.

We have thus been enabled to determine approximately the composition of pig suited to varying foundry requirements.

*Read at the meeting of the Foundrymen's Association at Philadelphia, May 3, 1899.

supplemented by the study of analyses of castings that were proved to be satisfactory. A blast furnace run in the old way could not now exist in competition with one managed under scientific methods.

Foundries Must Adopt Scientific Methods.

Unless all signs fail, the same rules of growth and existence will hold good as applied to the foundry trade, and the "survival of the fittest" will, sooner or later, compel all foundries to avail themselves of the help afforded by scientific methods. Many foundries are under most excellent management.

There are many able men connected with foundry work, combining practical experience with technical attainments. These men know what they want and are thus able to specify as to the composition of the pig iron required, and their specifications, as a rule, are reasonable from the standpoint of the blast furnace manager, which cannot be said of all the specifications submitted by agents. To such men the accident of fracture is immaterial, so long as the elements named are within the limits specified. The percentages of silicon and sulphur determine, in great measure, the adaptability of an iron for general foundry work or for special work. They take advantage of the general trade custom of grading by fracture, the market price varying within the grade, to buy a No. 2 iron and at the same time specify a composition that can only apply to a No. 1 iron. As soon as foundries generally are sufficiently well informed as to the composition of the iron they require, to specify the limits of silicon and sulphur, just so soon will the old system of grading by fracture disappear, and they will then be prepared to take advantage of the benefits afforded by the use of sandless pig iron, or pig cast into iron molds.

It would be presumptious for one having no practical acquaintance with foundry conditions, to advise or dictate to experienced men, but I am at a loss to conceive what benefit can be derived from converitng into slag 20 or 30 pounds of sand for each ton of pig melted in the cupola. There is a bare possibility that the slag thus made, in connection with the ashes of the fuel, is of assistance in removing the sulphur of the fuel. If this should prove to be the case, it would be a simple matter to add to the charge of clean pig, as much sand as may be required to make the necessary volume of slag. Much of the difficulty experienced in soft and gray foundry work, is due to the melting of the pig in the cupola, in contact with mineral fuel carrying more or less sulphur.

The presence of manganese in the pig helps to remove the sulphur but it is rather an expensive flux, paid for as it is, at the price of iron. The same may be said of sand, if its only use on the pig is to increase the volume of slag. While it is true that a certain allowance is made for sand on the pig, it is doubtful whether the purchaser obtains 2,240 pounds of actual iron for each ton. The allowance made for sand is to cover the loss in handling, so that the purchaser may not receive less than 2,240 pounds of iron, plus the sand that adheres tightly. With the use of sandless pig the purchaser would always receive 2,240 pounds of iron.

Resemblance Between Furnace and Cupola Practice.

There are many points of resemblance between blast furnace and cupola practice, enough to permit of arguing from one to the other. We have found that temperature, other things being equal, determines the percentage of sulphur in the pig. At high temperature of crucible or furnace, there is but little affinity between iron and sulphur; the slag takes up the sulphur, leaving the iron comparatively free. An unexpected stoppage, or a leaky tuyere, or any cause lowering the temperature of the crucible, will act to reverse these relations. The sulphur will attach itself to the iron. Sulphur in the pig increases the percentage of combined carbon and lowers the graphitic, thus affecting the crystallization, but not necessarily changing the percentage of silicon. Thus it is, that we occasionally get iron high in silicon, and, at the same time high in sulphur, high in combined carbon, and low in total carbon. This iron might show a fairly good fracture in the sand pig, but if cast in an iron mold, the high sulphur would develop a chill in spite of the silicon, thus indicating very plainly that the iron was not suitable for light castings or castings that were required to be soft enough to machine easily.

In the cupola, however low the pig iron may be in sulphur, if not melted down hot, sulphur will be absorbed from the coal or coke, and the casting will be high in sulphur. Very few cokes will average less than 1 per cent of sulphur, while anthracite coal will carry from ½ per cent to 1 per cent. High sulphur in the casting will cause the iron to be hard, owing to formation of combined carbon, and coming into contact with the damp sand of mold, it will take a chill and excessive shrinkage will develop.

The knowledge that the iron mixture is all right would enable the manager to locate the cause of the trouble. While it might be easier to blame the pig and claim a reduction in price, yet this does not remove the real cause and the trouble is likely to re-appear again and again, causing delays and loss.

While it is perfectly feasible to increase and multiply many times the percentage of sulphur in the pig, by re-melting in the cupola at too low a temperature, no elevation of temperature will reduce the percentage of sulphur in the melted iron below the percentage contained in the pig or scrap charged, though good cupola practice may prevent any considerable increase, through absorption of sulphur from the fuel. The blast furnace and puddling furnace and possibly the basic steel furnace, can break up the combination of iron with sulphur and eliminate the sulphur, but the cupola cannot. Hence all scrap, as a rule, carries a larger percentage of sulphur than the higher grades of foundry pig iron. All grades and compositions of pig have their uses, and even sulpur is valuable to fulfill certain requirements. The whole difficulty consists in knowing just what is wanted in any particular case and then adjusting mixture to suit

In "blowing in" or starting a blast furnace, some years ago, the first couple of casts were usually worthless, a sort of nondescript iron, fitted neither for foundry nor mill use. It was made with a hot furnace above the tuyeres, but in the crucible, below the tuyeres, it underwent changes for the reason that the crucible was not hot enough to maintain the temperature of the slag and iron. This was corrected by increasing the blank charge of fuel to such an extent that there was no possibility of either slag or iron reaching the crucible until its temperature was sufficiently high to prevent any change in either. Now, the first cast of iron will show about the same quality of product as any of the subsequent casts. I would argue from this experience that in cupola practice it not unfrequently happens that melted iron reaches the bottom of the cupola before the temperature is sufficiently high to prevent the iron from undergoing chemical changes.

When this iron is poured into molds, the castings are often worthless. The iron as charged at the top may be all right; as drawn at tapping hole, it is all wrong. Blaming the pig and changing the mixture will not correct the fault. Positive knowledge as to the composition of the iron mixture and equally positive data as to the requirements of the castings to be made, would remove elements of uncertainty, and enable the manager to locate the trouble, so as to avoid a repetition.

Effect of Atmospheric Conditions.

We also find that atmospheric moisture plays an important part in the economy of blast furnace work. Roughly speaking, about five tons of air are required to make one ton of iron. Last June and July, 245 pounds of water in the shape of vapor was driven into the tuyeres for each ton of iron made, or over 125 tons of water in a week. The usual average for the year is about 160 pounds of water per ton of iron; but of course this varies with the location of the furnace, as well as the season of the year. The water is converted into oxygen and hydrogen gas at the expense of fuel in the crucible. Unless this is provided for, the temperature is lowered, sulphur in the iron increases, changing the relative proportions of graphitic and combined carbon, effecting the fracture and the market value.

Cupola practice is affected in the same way, but to a less degree, because in melting iron, much less air is used per ton than is required to make the iron. It is, however, an important factor and must be provided for to guard against bad heats. We have also learned that coke, if exposed, will absorb from 10 per cent to 20 per cent of its weight of water. If coke is charged by weight, one day we may get 600 pounds of coke per barrow and another day 500 pounds of coke and 100 pounds of water, which is a poor substitute for carbon. On the

other hand, different cokes vary in specific gravity, equal bulks varying 10 per cent to 15 per cent or more in weight. If the furnace is charged by volume, while the absorption of water is provided for, we are subject to violent fluctuations because of variation in actual weight of carbon, if cokes of different specific gravities are used.

All of these causes must be guarded against in blast furnace practice to insure uniform results and economical working, and the same causes apply more or less to cupola practice.

There are a hundred and one causes affecting the character and quality of castings produced by a foundry, other than the fracture, grade, or quality of pig iron used. Such being the case, it becomes all the more important to eliminate, by the application of scientific and technical helps, such of the disturbing causes as are within control. There has been so much written of late upon the chemistry of cast iron as applied to foundry practice, the influence of the several alloys, silicon, sulphur, carbon, phosphorus, etc., that it is not worth while for me to discuss the subject, however attractive it may be.

My object has been to call attention to causes of trouble that are not often referred to. Other causes will suggest themselves to every experienced foundryman, that pertain solely to the foundry, especially to the fine art of molding, designs of patterns, treatment of sand, pouring of iron, condition of cupola, volume of air, etc.

Causes of Variations in Furnace Results.

The furnace manager has his own troubles also. To one well acquainted with the cast-house work of a blast furnace, the molding of the pig beds, the running or casting of the iron, and the physical causes by which the fracture of the iron is influenced, it has been a wonder that notwithstanding the advance in technical information, so much stress should still be placed, by our foundry friends, upon the accident of fracture, as governing the quality of the iron, to be used for any particular purpose. I do not question that the fracture is a guide to a certain extent, and the fact that it has been so long employed, in the absence of any better method, is proof of its old time usefulness.

There is room for so many mistakes and errors, however, that have been developed only by the accumulation of hundreds and thousands of analyses, that it would seem that this custom should no longer stand in the way of improvements, that ultimately would prove of more or less benefit to the foundries. There are many causes affecting the fracture, independent of the composition. The fracture may be a reasonably safe guide to the blast furnace manager, especially if he has made a study of many analyses, comparing them with the physical appearance of the iron, and knowing the conditions under which the iron was made and cast. I do not know of any better pyrometer to determine the relative temperatures of the blast furnace, than the silicon and sulphur contents of the iron. The time of cooling, or rather of the passage from liquid to solid state, and the silicon contents are exchangeble terms, the total carbon being constant.

Large masses cool slowly; graphitic carbon separates, even if silicon is very low. If the suction of a casting is ⅛-inch or less, causing the hot metal to cool quickly, silicon must be high to compel or force carbon to assume graphitic form, in spite of the rapid cooling. When a furnace containing 40 or 50 tons of iron is tapped, under a blast pressure of 8 to 10 pounds per square inch, the flow of metal down the main runner, supplying the rows of pig beds, may become unmanageable. The more rapidly the iron is run, other things being equal, the more open will be the fracture and the larger the proportion of No. 1X. We therefore aim to run foundry iron as fast as the men can handle it. Some beds may be sheeted or filled to overflowing while others may only be partly filled. The large pigs will go into the No. 1X pile, while the smaller ones, from adjoining bed, may be piled as No. 2. Some of the beds may not be level; they may hang too much in one direction. One-half of the pigs may be filled to overflowing, and the balance only partially. The bed is cut off.

The iron seeks its own level, passing from one set of pigs to another. The flow of the iron disturbs the crystallization, so that the pigs first filled, and from which the iron flowed to fill up the others, will show a No. 2 or even a No. 3 fracture, while the balance of the bed, and the beds adjoining above and below, may be No. 1. The face of the pigs thus drained will show a concave surface, because of the metal being withdrawn from the interior, while the pigs receiving this iron will have a convex face. The foundryman condemns the one because its appearance indicates high shrinkage, while the latter is entirely acceptable.

The first three or four pigs in each bed, the pigs that fill first, will almost invariably be No. 2 or even No. 3 in fracture, while the balance of the bed may be No. 1, for the reason that the iron is not at rest, the movement of the metal, some molds filling up and then emptying partially, interferes with the law governing the formation of large crystals. Sometimes an obstruction in the tapping hole causes the flow of iron to almost cease for a few minutes. If a bed happens to be only half full, the fracture will show No. 2, while the preceding bed, run more rapidly, and completely filled, will be No. 1. Slow running is destructive to open crystallization, while rapid running and slow cooling is favorable to open iron, and a large percentage of No. 1.

Now when we find that all of this iron is practically of the same composition, made under the same furnace conditions and that the differences in fracture are due solely to physica causes, the fallacy of grading one pig No. 1, and another pig only a couple of feet distant, in the same bed, No. 2 or even No. 3, becomes evident. Any inference that all the iron graded and sold as No. 2 and No. 3 foundry is sorted from No. 1 casts, and has the same composition as the No. 1, would be far from the truth. While it is true that a certain percentage of the lower grades show the same analysis as No. 1, yet by far the greater tonnage is made under different furnace conditions and will show different analyses. It sometimes happens that a foundry receives No. 3 grade, selected from a No. 1 cast, and finding that it answers the purpose just as well as No. 1, the buyer jumps to the conclusion that he will save considerable by using the No. 3, and places his order for a large amount. The next car received, while of approximately the same fracture, may have been made under different furnace conditions and be of entirely a different composition. Trouble follows and misunderstandings arise. Our pig beds are necessarily kept very wet, otherwise the cores will not stand. The molten iron is run 50 or 60 feet, in the main runner and subdivided into smaller streams into equally wet beds.

Analysis of Chill-cast and Sand-cast Iron.

It has been noticed that the same iron run into chill molds, shows higher percentage of graphitic carbon than when run into the sand beds. This probably can be accounted for from the fact that the iron molds are dry and frequently warm. The following analyses, made by a chemist of Burnham, Williams & Co., will illustrate:

	Graph. C.	Comb. C.	Total C.
Cast No. 81, drillings from sand pig,	2.57	0.42	2.99
Warwick cast No. 81, drillings from pig cast in iron mold,	2.87	0.48	3.35

Full analysis by H. V. Wille, chemist, Burnham, Williams & Co., Dec. 30, 1895:

	Cast No. 81. Chill Molds.	Cast No. 81. Sand pig.
Graph. C.,	2.87	2.57
Comb. C.,	0.48	0.42
Total C.,	3.35	2.99
Manganese,	0.42	0.41
Phosphorus,	0.36	0.36
Sulphur,	0.017	0.010
Silicon,	1.50	1.52

However regular any furnace may be working, and however uniform in appearance any cast may be, there is an unavoidable variation in the composition of one bed of iron of any one cast, compared with every other bed, and a variation between pigs of the same bed.

For some years past we have been sampling every cast liquid. The iron is taken from the main runner and poured into iron cups. The bottom of cup is 1 inch thick and the depth of liquid metal in cup is about 1 inch. These samples, as soon as they can be removed from cups, are quenched in water and drilled. The borings are mixed thoroughly, and analyzed. Frequently several analyses may be made for one cast, if any considerable difference is noted in different parts of the cast.

In order to secure practical uniformity, the different beds

of a cast are broken over a block, the different pieces are then sorted and piled by fracture, and by the time they are again handled in loading a car, there is such an intimate intermixture, that the car as loaded is fairly represented by the cast analysis. We invariably get two grades by fracture, from each cast, sometimes three, so that we will have two or three piles of iron, No. 1, No. 2 and No. 3 foundry by fracture, all of the same analysis. Even in the same pig, the appearance of the fracture depends upon whether the pig is broken in the middle, close to the sow, or close to the end or point. The crystals are the largest nearest the sow, the end that cools the slowest, while near the point they will frequently be small and lighter in color, because of more rapid cooling. To strike a fair average we aim to break each pig in the middle. If the pieces are re-broken at the foundry, there will be found a considerable variation. The half next to the sow when re-broken may be open, while the other half may be close. The crystals in the sow are more open than those of the pigs in the same bed, as the section is larger and the cooling proceeds slower. Hence it is that some furnaces make pigs of large section to please the eye of the consumer.

Uniformity can only be secured by unceasing watchfulness, and the exercise of the greatest care, together with the help afforded by analysis. We have paid especial attention to uniformity of shipments, and while any one or two pigs may not show the same analysis, differing from one another, and differing possibly from the average of the cast, yet the cast analysis will fairly represent the iron as used in quantity. Uniformity can only be secured by selection, guided by analysis, and by intimate intermixture. Appearances are very deceptive, even to the furnace manager, with all the helps afforded by knowledge of furnace conditions. Every cast may vary more or less from every other cast of foundry iron. The use of iron by brands or names or grades does not furnish any guarantee of uniformity, unless there is selection and care exercised at the furnace. We are more or less dependent upon ignorant and inefficient help, subject to errors of judgment and of ignorance and carelessness, so far as grading by fracture is concerned.

Foundrymen and Chill-Cast Iron.

We have recently been considering the adoption of a casting table. A favorable decision is necessarily dependent upon the favor with which such a departure from old methods will be received by our foundry customers. The mill consumers will offer no objections, but there is more or less doubt in regard to the foundry trade, especially the smaller class of foundries. I question whether there would be any pecuniary advantage to the furnace company, as the investment for one furnace would be so large as to counterbalance any possible saving in cost of handling our product in this way, as compared with sand pig. Our advantage would consist in doing away with the most arduous work around the furnace and at the same time enable us to ensure greater uniformity in our shipments and be less dependent upon ignorant and unskilled labor. In explanation of this statement, the following method of procedure will probably be convincing:

Upon tapping the furnace, the molten iron will be run into 20 ton ladle cars, a cast of 40 tons will require two cars. When the first car is filled, the iron will be poured into molds made of cast iron or plate steel, coated with loam or lime, to protect them and insure no sticking. It is evident that the iron of the first ladle will be so intimately mixed by the filling and pouring, that each mold will contain iron practically of the same composition, which will be cooled under practically the same condition, hence the lot of 20 tons, pig for pig, will be more nearly uniform than is possible under the present method of running an equal tonnage into ten different beds. Each ladle will be sampled and analyzed, so that the composition of each car load of 20 tons will be definitely known.

The effect of the iron mold upon the fracture of the pig will probably be to tighten or close the grain somewhat, so that the present custom of grading by fracture would have to be modified to meet the changed conditions, or a system of grading developed depending upon the composition. For instance, an iron of 2.50 per cent to 3.00 per cent silicon and 0.02 per cent or less sulphur would be No. 1.

Silicon 2.00 to 2.50, Sulphur 0.02 and under	No. 2X.
Silicon 2.50 to 3.00, Sulphur 0.05 or less	No. 2 soft.
Silicon 2.00 to 2.50, Sulphur 0.05 or less	No. 2 plain.
Silicon 1.50 to 2.00, Sulphur 0.05 or less	No. 2 strong.
Silicon 1.50 to 2.50, Sulphur over 0.05	No. 3 foundry.

In the absence of any grade number, specifications would call for the silicon and sulphur to suit the particular requirements of the purchaser.

If the pig iron was used directly in the form in which it comes from the furnace, that is, if the pig itself was planed and drilled, etc., the objection that the chilling action of the iron mold would harden the surface of the pig, might be valid enough, but as the pig is re-melted, this objection would seem to lose its force. Other things being the same, the temperature of the blast furnace determines the composition of the iron and the composition of the iron after being re-melted in the cupola, determines as a rule, occasionally apparent exceptions occur, the quality and fitness for any particular class of castings. Whatever may be the method of casting at the blast furnace, whether the iron is run into wet sand, dry iron molds, or granulated by running into water. In the latter case all of the carbon would be combined, and the particles, or pebbles of iron, would be white.

If the iron thus changed to white by rapid cooling, had been made in a hot furnace and contained 3 per cent silicon and not over 0.02 or 0.03 per cent sulphur, upon re-melting in the cupola, it would make a soft gray stove plate or the lightest hardware casting, without any evidence of chill. This has been practically demonstrated.

Iron Cast in Molds Gives Best Information.

Our experience with our sample chill cups, extending over many years, and representing thousands of casts and analyses, would prove that iron cast in metal molds instead of sand, will indicate to the purchaser, after a little experience, more accurately the quality of the iron for foundry uses than it is possible to gather from the fracture of any sand pig. We can guess approximately the composition of any cast by the appearance of the fractured chill cup samples, while we would go very far astray frequently if we relied upon the fracture of the pigs of the same cast, as the fractures vary so greatly, depending upon the sizes of the pigs, the manner in which the iron was run, etc. By comparing the chill cup samples, day after day, with the analyses, we find that the chill cup not only acts as a guide so far as the silicon is concerned, but is an infallable detective of sulphur.

Our pig iron, low in manganese, with 1.5 per cent silicon and sulphur down to 0.03 per cent, will not take a chill in this cup. If the silicon falls to 1 per cent, with sulphur 0.02 per cent, there may be a slight chill, but let the sulphur increase to 0.08 per cent, a chill ½-inch in depth will show. Pig with 2 per cent to 3 per cent silicon, and sulphur up to 0.05 per cent, will not chill in the cup, but if the sulphur increases to 0.10 per cent, even 3 per cent silicon iron will show a chill. The chill caused by sulphur is entirely different in appearance from that produced by low silicon and is easily distinguished. With pig of 0.50 per cent silicon and low sulphur, the test piece 1 inch thick will show ½-inch chill. If the sulphur is high, say about 0.10 per cent, the test piece will be solid white. The most beautiful iron of No. 1 fracture is the low silicon and low sulphur variety, with high carbon. Such an iron, re-melted in a cupola and run into thin castings, would be white and brittle. Run into heavy castings, like ingot molds, it will be soft and strong, outlasting many times the ingot molds made of 2 to 3 per cent silicon pig.

Our experience with the chill cup test pieces, showing the influence of sulphur, has enable us to render more or less assistance in accounting for many of the troubles our foundry friends encounter. It is not common for the higher grades of the best makes of foundry iron to contain sufficient sulphur to be injurious, but in re-melting, if the cupola is not hot enough, or if the bottom is too cold to receive the iron, the absorption of sulphur from the fuel is frequently ruinous. Hot, high silicon iron, coming into a comparatively cold bottom, or tapped into damp and cold ladles, will undergo

chemical changes, causing a white core, surrounded by a gray skin, that frequently causes the loss of many light castings.

Advantages of Sandless Pig to Small Foundries.

Foundries, therefore, that operate on too small a scale to warrant the employment of a chemist, or large foundries, depending upon the analyses furnished by the furnace company supplying them with iron, can soon learn to judge sandless pig and determine the quality by inspection much more accurately than is possible with sand pig, however experienced and skillful the inspector. In purchasing a carload of sandless pig the buyer is sure to get as many pounds of iron as he pays for. It will not be necessary to melt tons of sand in a year, except as it may be found necessary to use it as a flux, and then it can be added in the shape and in the quantity that may be most convenient and economical.

The secret of success, in foundry as well as in blast furnace practice, is to know enough to know how little one knows and how much there is to be known, close application and hard work. I quote as follows from a recent letter of Mr. Thomas D. West: "You may not be aware of it, but the fact is that if one-half of one cast is run into sand mold and the other half into chill molds, the latter would give the softer iron when re-melted. Chilling of pig metal can only effect the state of the carbon. The silicon, sulphur, manganese, and phosphorus remains the same in both cases, so that as long as you have 2.50 to 3.00 per cent silicon, and not over 0.02 per cent sulphur in the cast, it matters not if the pig showed a chill, the iron would make a softer casting than had it been cast in sand molds."

As a matter of fact, it is extremely doubtful whether a pig iron with 2.50 to 3.00 per cent silicon and 0.02 per cent sulphur could be made to show a chill by casting in any iron mold. It would have to be run into water in order to cause sufficient carbon to assume the combined form and thus cause the iron to become white. When the blast furnace is making high grade of foundry iron, the atmosphere of the casting-house, when the iron is being run, is filled with kish or graphite, thrown off by the molten iron. The trough and sand runners frequently show graphite in abundance. When the molten iron is at rest in the beds, graphite can be noticed floating on the surfaces of the pigs. As the iron cools slowly, the graphite seems to accumulate on the surfaces, the quantity increasing the slower the iron passes from the liquid to solid condition. When the same iron is cooled quickly, as frequently happens when a bed is partially sheeted, and a thin layer spreads over the cores separating the pigs, this does not separate graphite. The quicker cooling seems to confine the carbon and keep it in the iron. Of course the graphitic carbon that exudes is washed off when the pigs are sprinkled with water and is lost.

The exudation of carbonaceous powder on the pigs is the more evident the lower the silicon contents, that is, with the iron carrying 1.25 to 1.75 per cent silicon, the amount of carbon thus separated is greater than when the iron carries 2.00, 2.50 or 3.00 per cent silicon. The face of this pig has a peculiar etched appearance, indicative of strong pig. A hot furnace, and consequently low sulphur, is a necessary condition. This fact may explain the assertion of Mr. West. Iron run into chills sets more rapidly than when cast in sand, which may thus act to retain the carbon.

The analysis of Mr. Wille, chemist of Burnham, Williams & Co., of cast No. 81, shows 3.35 per cent carbon in the pig cast in chill molds, as compared with 2.99 per cent in the sand pig. The same chemist made determinations of other casts of Warwick iron as follows:

Cast No. 83.	Sand pig.	Iron in chill molds.
Comb. carbon,	0.42	0.68
Graph. carbon,	2.48	3.03
Total carbon,	2 90	3 71
Manganese,	0.40	0.51
Phosphorus,	0.42	0.41
Sulphur,	0.012	0.056
Silicon,	1.52	1.24
Cast No. 91.		
Comb. carbon,	0.49	0.54
Graph. carbon	2.03	3.01
Total carbon,	2.52	3.55
Manganese,	0.52	0.51
Phosphorus,	0.38	0.44
Sulphur,	0.010	0.010
Silicon,	1.38	1.28

We have not run any iron into chill molds since the early part of 1896, and have no further data on this subject. Our carbon determinations are made from samples obtained by drilling the pigs, all other elements being obtained by drilling of chill cup samples.

Since my attention has been called to this side of the question, we have had time to make only a few determinations of carbon from chill cup samples, compared with pigs of the same cast, as follows:

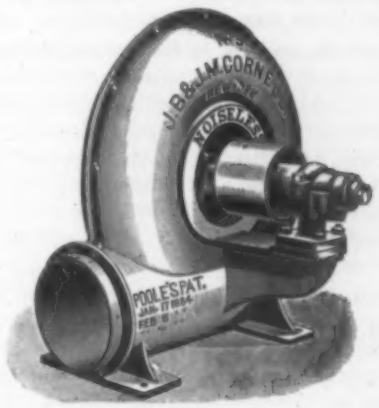
	Sand Pig.		Chill Cup Samples.	
	Cast 124.	Cast 132.	Cast 124.	Cast 132.
Graphitic Carbon,	3.40	3.59	3.58	3.64
Combined Carbon,	0.46	0.07	0.50	0.25
Total Carbon,	3.86	3.66	4.08	3.89

A distinction is to be made between iron run into chill molds, arranged in series corresponding to the beds of sand, and iron cast in molds arranged on a casting table, the molds being filled by pouring from ladle car. The uniformity pertaining to the latter method, pig for pig, will not apply to former, which are filled under the same conditions that apply to sand beds.

POOLE PATENT PRESSURE BLOWERS.

J. B. & J. M. Cornell, of New York, who have a foundry capacity at their various plants of nearly 50 tons an hour, secured control of the Poole blower, after having used it with good results in their foundries, and are bringing it prominently before the trade at large. Their own experience was that the iron came down very hot and very rapidly by the use of the Poole blower, and at a substantial saving. The machines are thoroughly built, with self-oiling spherical bronze bearings; and all are carefully tested and registered before leaving the shop and are sent to the buyer with every guaranty of perfect construction and operation.

The feature of the Poole blower is the bucket wheel—a new application of an old principle. A partial vacuum is produced in the buckets which the air rushes in to fill. Once it



is in the buckets, centrifugal force is utilized to empty them of it, the propelling force of the curved blades gradually changes the direction of its travel, and the combination of all three creates and holds the pressure. With this combination the full capacity of the intake is handled and the air is given free, unimpeded travel. The operation is thus expressed by the manufacturers: "The partial vacuum created by the Poole wheel practically pulls the air through a straight-sided or slighly flaring hole, then it is coaxed forward gradually with the minimum friction, so that all the power is utilized and the full benefit of the large intake obtained."

The Akron Machine Co., Akron, O., make a full line of drop forgings and metal stampings; also special dies, molds for hard and soft rubber work, highly polished electro-plating, and fine machine work. Other lines are agricultural tools, and machine supplies, such as mower knives, binder and reaper sickle sections, spring keys and cotters, haying tools, spray pumps, lawn mowers, plow repairs, cultivator shovels, etc.

Wm. Frankham, 736 E. 7th st., Canton, O., for the past 35 years has been turning out a line of high class brass model and pattern work. For one concern alone over 500 models for use as salemen's samples were made. The trade includes Germany, South America, and Mexico. Fine work in brass, bronze, bell metal and gun metal castings has given this shop a wide reputation.

Industrial Centers of Illinois

Important Agricultural, Machine Shop, Foundry and Other Plants.

MOLINE.

Barnard & Leas Mfg. Co. manufactures special mill and elevator machinery and wood split pulleys. Mills are also built and furnished. H. A. Barnard is president of the company; J. S. Leas, vice-president; W. C. Bennett, treasurer, and C. A. Barnard, secretary. The business was established in Moline in 1860 by L. E. Hemenway, Joseph Wyckoff and H. A. Barnard. The latter has made many inventions which are widely used in the flour mill world.

The Moline Elevator Co. is located at Moline, Ill., and manufactures power and hand elevators for freight and passengers. Gear cutting and general machine work are also done. The plant occupies a space 80x300 feet and has a well equipped foundry and machine shop and wood-working department.

H. W. Cooper, Moline, Ill., manufactures a large line of staple saddlery, hardware and patented specialties, such as pad trees, collar fasteners, trace buckles, trace carriers, clips, etc. These have found a large sale throughout the country and the business has grown largely since 1888, when Mr. Cooper went to Moline from Chicago.

Moline Plow Co.—Another of the important implement concerns at Moline is the Moline Plow Co. The plant is one of the largest in the world and consists of 17 buildings. The company has seven branch houses in this country and agencies abroad. The officers are G. Stephens, president; G. A. Stephens, vice-president; F. G. Allen, secretary and treasurer, and C. R. Stephens, superintendent. The plows manufactured by the company include all styles of riding and sulky plows, sulkys, gangs, etc. Other products include drills, planters, cultivators and rakes. A large new foundry and a 10 story warehouse are now under way.

The Deere & Mansur Co. is located in Moline, where it was established in 1877 for the purpose of manufacturing a corn planter. It has grown into an extensive establishment and now in addition to the corn planter there are manufactured disc harrows, drills, seeders, cultivators, loaders, shellers, potato planters, and a great variety of agricultural machinery of approved types. The officers are Chas. H. Deere, president; J. W Good, vice-president; G. W. Crampton, secretary, and James Barclay, treasurer.

Williams, White & Co. are located at Moline, and manufacture forging machinery, coal chutes for coaling locomotives, bulldozers, steam hammers, rolling machines, etc. They have supplied the smith departments of some of the largest agricultural implement manufacturers. The officers are H. A. Ainsworth, president; C. R. Ainsworth, vice-president; J. J. Williams, treasurer, and Harry Ainsworth, secretary.

The Moline Pattern Works.—This concern, of which D. A. Gamble is manager, furnishes all kinds of light malleable and gray iron patterns. Die work and sheet metal stamping is also done, and patterns and drawings are furnished. Mr. Gamble has had 18 year's experience in these lines.

Deere & Co., of Moline, are engaged in the manuacture of agricultural implements. Their factories, in which the John Deere plows have been made for 60 years, are among the largest in the world and the aggregate annual business has reached great proportions The company has branch houses in Kansas City, St. Louis, Council Bluffs, Minneapolis, San Francisco, and Keokuk, Ia.

The Union Malleable Iron Co. is located at 709 3rd ave., Moline. The concern manufactures refined malleable castings and castings for wagon and agricultural implements. One of its specialties is Heald's patent gear link drive chain.

PEORIA.

Peoria Foundry Co.—This concern has been in existence for seven years and has a large plant, the main building being 60x205 feet. Mr. Fitzgerald has been a foundryman all his business life, covering a period of 31 years. All descriptions of gray iron castings are manufactured, and a specialty is made of architectural cast iron work.

The Peoria Rag & Metal Co., Peoria, Ill., has been in business for two years, resided in Peoria for 20 years. Grades scrap for mills. M. Cohen, proprietor.

Smith & Carpenter, Peoria, Ill., are manufacturers of special and fine machinery. The plant is at 413 S. Washington st. The firm is comparatively new, having started up three years ago. Both members of the firm are experienced machinists and die makers.

J. C. Armstrong, Peoria, established his business in 1876 at 830 South Washington st. The plant covers 45x150 feet. All kinds of machinery are made and repaired.

W. Cinofsky & Co. 721 723 S. Adams st., Peoria, deal in scrap iron, steel, metals, and rubber. Mr. Cinofsky has spent 20 years in the business, formerly in Indiana. The yards are 90x180 feet. There is also a yard corner of Chestnut and Adams sts. The firm grades scrap for foundries and rolling mills, and its business is growing with years.

The Peoria Scrap Iron Co. has offices and yards at 101-115 Edmond st., and 1501-1515 S. Water st. Specialties, classification iron sheared to order boiler plates, all kinds of second hand machinery, iron, steel rails, old car wheels, railroad scrap, etc. H. V. Finklestein, is at the head of the company.

The Excelsior Foundry Co. 101-105 Pecan st., Peoria, manufactures all kinds of castings. The business was established in 1897; the plant is 90x60 feet. John F. O'Brien, secretary and treasurer, was connected with the Peoria Foundry Co., and has been in the business 15 years.

The Keystone Woven Wire Fence Co., Peoria, was established in 1889 and incorporated in 1892. Capital, $150,000 The plant covers four acres, and floor space is about 18,000 square feet. The company does considerable export business, but principal output is taken in the Central West. For the past year the plant has run night and day. Officers: Peter Sommer, president; John Sommer, vice-president; P. W. Summer, secretary and treasurer.

The Monarch Machine Works, of Peoria, J. C. Flanigon, consulting and mechanical engineer, proprietor, manufacture engines, pumps, mill elevators, cooperage and distillery machinery. They have machine and blacksmith shops, among the largest in the state outside of Chicago, and pay special attention to repair work. The Watertown and Leffel engines and boilers are sold.

H. V. Finklestein, whose business has been removed to the old Northern Distillery, Peoria, has large and ample warehouse space and carries in stock engines, from 1 to 1,000 h. p., new and second hand; boilers from 5 to 150 h. p.; all sizes of pumps, iron and wooden tanks, heaters, pipe, I beams and channels, rails, new and second hand belting, hose and lacing, brass and iron fittings, new and second hand bar iron, and iron safes of all sizes. A specialty is made of dismantling factories.

ROCKFORD.

The W. F. & John Barnes Co., of Rockford, Ill., has been in business since 1875. Its reputation is widespread and its products are now shipped all over the world. Its specialties are upright drilling machines, foot power lathes, and a complete line of hand and power wood working machinery. The floor space is 60,000 square feet, and 250 men are employed.

The Andrews Wire & Iron Works of Rockford, Ill., manufacture a large line of wire goods, household goods, photo easels, flower pot stands, bank and office fittings, elevator enclosures, etc. During the seasons of '97-'98 a line of high grade wire work toys has been manufactured and this has proved very successful.

The Rockford Tool & Sundry Mfg. Co., located in Rockford, Ill., makes sheet metal parts, including connections braces, ferrules, attachments and patented articles. A specialty is made of experimental work. The concern also manufactures the Hoffman Giant roller, bicycle brake. The business was founded in 1889.

The Illinois Sewing Machine Co., Rockford, Ill., is incorporated with capital paid up of $100,000. It manufactures the "New Royal" machine, marketed as a high grade family sewing machine and sold at popular prices. The com-

pany succeeded the Royal Sewing Machine Co., four years ago. W. C. Free is president; F. G. Hogland, secretary, and E. A. Clarke, treasurer. The business during the past year has been very satisfactory and is growing every month.

The Union Foundry & Machine Co. is located at Rockford, under the proprietorship of Geo. Peterson. The products are columns, pilasters, lintels, and other gray iron castings. Agricultural work is one of the specialties.

The Rockford Bolt Works.—This concern, located at Rockford, Ill., manufactures a large line of bolts of all kinds, such as stove, tire, bridge, roof and carriage bolts. A specialty is also made of plow and machine bolts and of machine screws, thumb and cap screws and nuts, of all styles. R. H. Tinker is president of the company; H. B. Utter, vice president, and C. R. Wise, secretary and treasurer.

OTHER CITIES.

The Stover Novelty Works, Freeport, Ill., were founded in 1892 and have grown rapidly. This firm manufactures a number of excellent machines, including the Stover power hack saw, the frictional disc drill, radial assembling drill, bicycle drill and various machines for the manufacture of bicycles and wire specialties. Conspicuous among the latter are the fence looms for diamond shaped wire fence. F. W. Hoefer is manager, A. G. Hoefer has charge of the experimental department, and E. A. Hoefer, another brother, supervises the machine work.

G. D. Colton & Co., Galesburg, Ill., were established in 1855, and incorporated in 1882. The plant was recently destroyed by fire, and is now rebuilding, will be in operation by June. Meantime work is being done in rented quarters. The new foundry will be 72x88, of fire-proof construction, and fire-proof pattern rooms. O. J. Colton, president and general manager, has spent all his life as a foundryman. The foundry was originally established by G. D. Colton, father of the present manager.

The Springfield Wire Screen Co., at Springfield, manufactures Smillie's door and window screens. The Illinois State Fair dome building, erected at a cost of $75,000, the dome being 186 feet in diameter, is screened with the products of this company. The business was established in 1877 and has grown to large proportions.

J. Joseph & Co., office and yards 2-18 Walnut st., Aurora, Ill., have been engaged in the scrap iron business for ten years. The firm is composed of Jacob Joseph and Israel Joseph. They have excellent facilities for handling iron and metals. The firm refers to the German American National Bank, Aurora.

The H. Mueller Mfg. Co., of Decatur, Ill., have long been representative manufacturers of high grade brass and water works goods. The business dates from 1852, when H. Mueller started business in Decatur, as a gunsmith. At the present time Mr. Mueller and his grown sons manufacture a full line of plumbers' high grade brass goods, the well-known water tapping machines and water works specialties of their own patents. They occupy an ideal factory employing 225 men, and work day and night to keep up with an ever increasing business. They have recently placed upon the market a gas tapping machine for tapping under pressure up to three inches.

The Sattley Mfg. Co., of Springfield, manufactures riding and walking plows, cultivators of all kinds and a general line of agricultural implements, including lever harrows, corn planters, and Capital City steel straw stackers. The growth of the business has been unprecedently rapid, the concern removing in 1889 from Taylorville, Ill., where it had carried on the business in a small way for a number of years. From a total of $50,000 the first year, there has been a steady increase, and 1899 bids fair to reach almost a million. The officers are the following well-known Springfield men: M. Sattley, president; J. T. Peters, vice-president; A. Sattley, second vice-president; S E Prather, secretary and treasurer.

The American Foundry & Furnace Co., of Bloomington, Ill., which succeeded the Soper Foundry Co., in 1896, is making numerous additions and improvements to meet the demands of its growing trade, adding some 15,000 feet of floor space and generally remodelling the plant. They report a large improvement in trade in the West, while in the East, they are more than holding their own as compared with former years. The apparatus for heating and ventilating a modern school building, together with the indoor closets, etc., makes the construction of the line of goods made by this company much more extensive and complete for every building than it has ever been before. The company is now well located with sales connections in various cities and is furnishing heating and ventilating and sanitary closet apparatus for a very large number of buildings.

The Moseley Lathe Co.—This concern is located at Elgin, Ill., succeeded Moseley & Co., in the manufacture of lathes, chucks, etc. J. M. Clark is proprietor and H. N. Mosely, manager. All the company's chucks bear the stamp Moseley.

Woodmanse & Hewitt Mfg. Co.—This concern is located in Freeport, Ill., and its specialty is the Mogul windmill, manufactured for farm and domestic water power. The works have been operated to full capacity and are now well supplied with orders.

Geo. W. Brown & Co. are located in Galesburg, Ill., with a branch house in Kansas City. They manufacture a great variety of agricultural machinery, including Brown's oscillating and rotary drop corn planters, check sowers, steel beam cultivators, and the Leidy cotton and corn stalk cutters. Geo. W. Brown is president.

Henry Keiser, with shops at 206-208 E. Market st., and office 505-507 North East st., Bloomington, Ill., manufactures and deals in machinery and mechanical supplies. He supplies power plants, sanitary plumbing, steam and water heating and heavy hardware.

American Foundry & Furnace Co.—This Bloomington, Ill., concern succeeds the Soper Foundry Co., as manufacturers of warming, ventilating and santiary apparatus for all purposes.

H. Mueller Mfg. Co. is located at Decatur, Ill., and manufactures water and gas tapping machines, water pressure regulators, stop and waste cocks, etc. It deals generally in water and gas works and plumbers' supplies.

The Illinois Cutlery Co.—This company manfactures serrated edge knives and makes and sells a large line of hardware specialties. The office and works are located at Decatur, Ill.

Chambers, Bering, Quinlan Co.—Agricultural implements manufactured at this company's extensive plant in Decatur, Ill. The various specialties are hay rakes, corn planters, horse drills, cultivators, hay loaders, shoveling boards, etc. The plant occupies three acres of ground, and was established in 1876. The officers are J. E. Bering, president; W. M. Bering, vice-president; Wm. J. Quinlan, secretary and treasurer.

The Moseley Lathe Co., of Elgin, Ill., manufactures the American hollow spindle bench lathe and the split self-centering chuck. The designs originated with C S. Mosely in the first watch factory of the country in 1852. Much automatic machinery has been made possible through these inventions. The E. A. Kinsey Co., of Cincinnati, O., also sells these lathes. J. M. Clark is proprietor of the concern and H. N. Moseley, manager.

C. W. Shumway & Son are proprietors of the Island Foundry Works, at Batavia, Ill. The business was started by the elder Shumway in 1872 and in that time did much of the iron work used in rebuilding the burned district of Chicago. The concern does a jobbing business in machinery and heater castings for firms in Chicago, Batavia and other cities.

J. Joseph & Co. located at 64-70 N. La Salle st., Aurora, are wholesale dealers in old machinery and scrap iron. Rags and metals are also bought and sold.

The Arcade Mfg. Co., of Freeport, manufactures coffee mills, spring hinges, stove pipe dampers, and other hardware specialties. The company has a large foundry and makes gray iron castings on contract. The output has been materially increased in the past year.

McCabe's Scrap Iron Co., Galesburg, Ill. Robert McCabe, the head of the company, has been in business here for 20 years. The company grades scrap for rolling mills and foundries. Their average output is five cars a week.

The Capital Foundry, Ferris & Foley, proprietors, Springfield, is located at 10th and Capital ave. The foundry is just completed and began melting iron last week. Both men are practical founders of years' standing. The capacity of the plant is four tons a day.

THE IRONSIDES CO.'S PRODUCTS.

Prominent as a manufacturer of special lubricants is the Ironsides Company, of Columbus, O., into which the Neil-Watson Oil Co. was merged about one year ago. The company's specialties are materials for lubrication, preservation, and protection of wire ropes, fibre ropes, and gearing. Operative wire ropes are made with a fibre core to conform readily to bends in passing around pulleys In adjusting to these curved shapes, the several strands necessarily change their relative positions, and, unless specially provided for, abrasive wear results. Many wire ropes are also exposed to the elements, wet and acid mines, wet conduits in street railway service, and other surroundings favorable to rapid water-soaking. To prevent this a material designated "wire rope filler" shown in black in Fig. 1, is furnished wire rope manufacturers for incorporation in the manufacture of wire ropes. This material lubricates and prevents the fibre core and the metallic interior of wire ropes, while the exuding portion thoroughly seals against gaseous, acid, or water attacks.

The lighter lines in the same illustration show the application of a material for external use, known as "wire rope shield." Where applied on ropes already treated internally, it speedily builds into rounded shape, protecting not only the wire rope, but all wheels with which it may come in contact. Other materials are shown in Fig. 2, representing internal

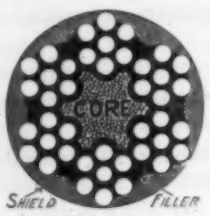


FIG. 1.

FIG. 3.

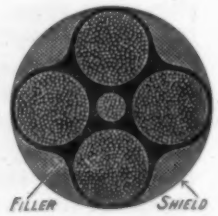


FIG. 2.

and external applications to fibre ropes of manila, jute, sisal, cotton, etc., and used not only for power transmission ropes, but also for all ropes for general purposes, and has proven specially valuable in excluding moisture from exposed fibre ropes, and those in such common use on ship board and around water ways, where water soaking followed by partial drying proves so destructive. Fig. 3 shows application of a material known as "gear shield," to gearing teeth, the fundamental principle of which is adherence and building up of a lubricating deposit on the surfaces of the teeth, preventing metallic contact, cushioning shocks, and consequently prolonging life of gearing, which explains its great success in all lines of gearing, from the rapid running gearing of street cars, to the most ponderous gearing of heavy rolling mill practice to which it is applied.

The foregoing are specialties out of a large line of manufactures that have brought prominence to this Columbus institution. Extensive improvements were necessary during the past year to provide for the increased demands, and others more important are now under consideration. C. H. Neil, a well-known Columbus capitalist, is president and treasurer of the company, W. H. Bone, formerly manager of the Walker Co., of Cleveland, is first vice-president and general manager, W. M. Watson, of Scranton, Pa., second vice-president, and W. J. Camnitz, secretary.

John Lauer, 112-114 Antoine st., Detroit, Mich., is very well established in the line of special machinery, tools and metallic furnishings. Everything in this class of work will receive expert attention. The metallic furnishings turned out for use on artificial limbs, have been for years favorably known to the trade. The present plant being inadequate to meet the demands of the business, it is being enlarged by a 25-foot addition, four stories high.

The Star Drilling Machine Co., Akron, O., recently made their third shipment to Honolulu in a period of four months, of portable drilling machines, the value aggregating over $7,000. Their export business last year amounted to $30,000. Machines for oil, water, gas and mineral prospect work are turned out, and have become known as standard throughout the business world. Their order books are very full at present and works are running up to full capacity.

ENGLISH VS. AMERICAN SHIPYARD WAGES.

Some time ago the *Marine Review* published a comprehensive comparison of wages paid to the various classes of workmen in British and American shipyards, which has been prepared by Mr. Charles H. Cramp, of the great Philadelphia shjp building firm, for presentation before congressional committees having under consideration the Hanna-Payne bill to grant subsidies to American-built vessels. The article was extensively copied in technical publications of the United States and Great Britain, and some of the statements made by Mr. Cramp were severely criticised. These criticisms were not, however, backed up in any case by conclusive evidence on the subject. They have served to arouse Mr. Charles Schofield, superintendent of mechanical work at the Cramp yard who by reason of his position and certain connections on the other side, is enabled to discuss the subject from a convincing standpoint. Mr. Schofield says:

"My attention has been called to a newspaper article in which a doubtful English authority is quoted as applying the terms 'arrant nonsense' to certain facts published in this country some time ago as to the rates of compensation paid to ship yard mechanics in this country and in England respectively. The statements quoted from the English authority referred to are misleading and calculated to deceive the public. In order to correct or prevent any such result I have compiled some information on the subject which is absolutely aceurate.

"I learned the ship building business in England, I have a brother who is a partner in the ship and engine building establishment of Schofield, Hagerup & Doughty, Limited, located at Grimsby, on the east coast of England. I am thoroughly familiar with the rates they pay their mechanics, and these rates are universal in that district. They may be taken as the mean or average rate of wages, as between Clyde and Tyne, and Liverpool and London. The schedule which I give of English wages is taken verbatim from the pay rolls of ship yards in the eastern district, centering at Hull; and I have taken the rates paid here in Philadelphia to represent the average in this country, as follows:

PHILADELPHIA PRICES—DAY WORK, 10 HOURS A DAY.

Carpenters	$3.00—12s. 6d.
Fitters	2.50—10s. 5d.
Riveters	2.00— 8s. 4d.
Caulkers	2.20— 9s. 4½d.
Drillers	1.75— 7s. 3½d.
Helpers	1.25— 5s. 2½d.

PIECE WORK PRICES—RIVETING PER 100 IN PHILADELPHIA.

1 inch rivets, shell	$4.00
1 inch rivets, inside	3.50
⅞ inch rivets, shell	3.00
⅞ inch rivets, inside	3.00
¾ inch rivets, shell	2.75
¾ inch rivets, inside	2.75
⅝ inch rivets, shell	2.25
⅝ inch rivets, inside	2.25
½ inch rivets, shell	2.00
½ inch rivets, inside	2.00

HULL, ENGLAND, PRICES—DAY WORK, 9 HOURS A DAY.

Carpenters	5s. 6d.
Fitters	6s. 4d.
Riveters	5s. 3d.
Caulkers	5s. 3d.
Drillers	4s.
Helpers	3s. 4d.

PIECE WORK PRICES—RIVETING PER 100, HULL, ENGLAND.

1 inch rivets, shell	$2.50
1 inch rivets, inside	2.49
⅞ inch rivets, shell	2.08
⅞ inch rivets, inside	2.00
¾ inch rivets, shell	1.79
¾ inch rivets, inside	1.75
⅝ inch rivets, shell	1.59
⅝ inch rivets, inside	1.47
½ inch rivets, shell	1.12
½ inch rivets, inside	1.10

"As I said before, this is not guess work on my part, but an absolute transcript from the books of existing and active establishments. Comparison of the rates of wages paid as given above will I think conclusively demonstrate the reason why it costs more to build any given type or class of ship in the United States than in England, without further comment or analysis."—[Marine Review.

A DULUTH dispatch says that the Drake-Stratton Co., employing 1,500 men on the Misabe range, has raised the wages of common laborers from $1.50 to $1.75. Mining companies are all short handed. Resident Italians are making efforts to bring over more of their countrymen.

LORAIN STEEL CO.'S FURNACES.

In *The Iron Trade Review* of July 7, 1898, was given a complete description of the projected blast furnace plant of the Lorain Steel Co., at Lorain, O., taken from the plans, which were then fully completed, while the construction had reached a stage indicating something of the proportions of the work. Now that the plant is virtually finished, and nearly ready for the blast, we take pleasure in reproducing some recent photographic views that will give an idea of the appearance of the new stacks. By way of memorandum a few facts from the original description may be recalled: Work was begun in April, 1898. The stacks are 100 feet high, with diameter of 14 feet in the hearth, 22 feet in the bosh and 15 feet in the throat. Their capacity will be 500 to 600 tons of iron in 24 hours. Ore is unloaded directly from boats by the company's hoisting equipment, the end of one group of these machines appearing in Fig. 1. There is ample yard room for winter ore, but during the season of navigation ore for current consumption will be unloaded directly into cars and these switched to the track over the bins alongside the furnaces, as shown. These underground bins extend for 620 feet in front of the furnaces, and between the latter and the ore yards

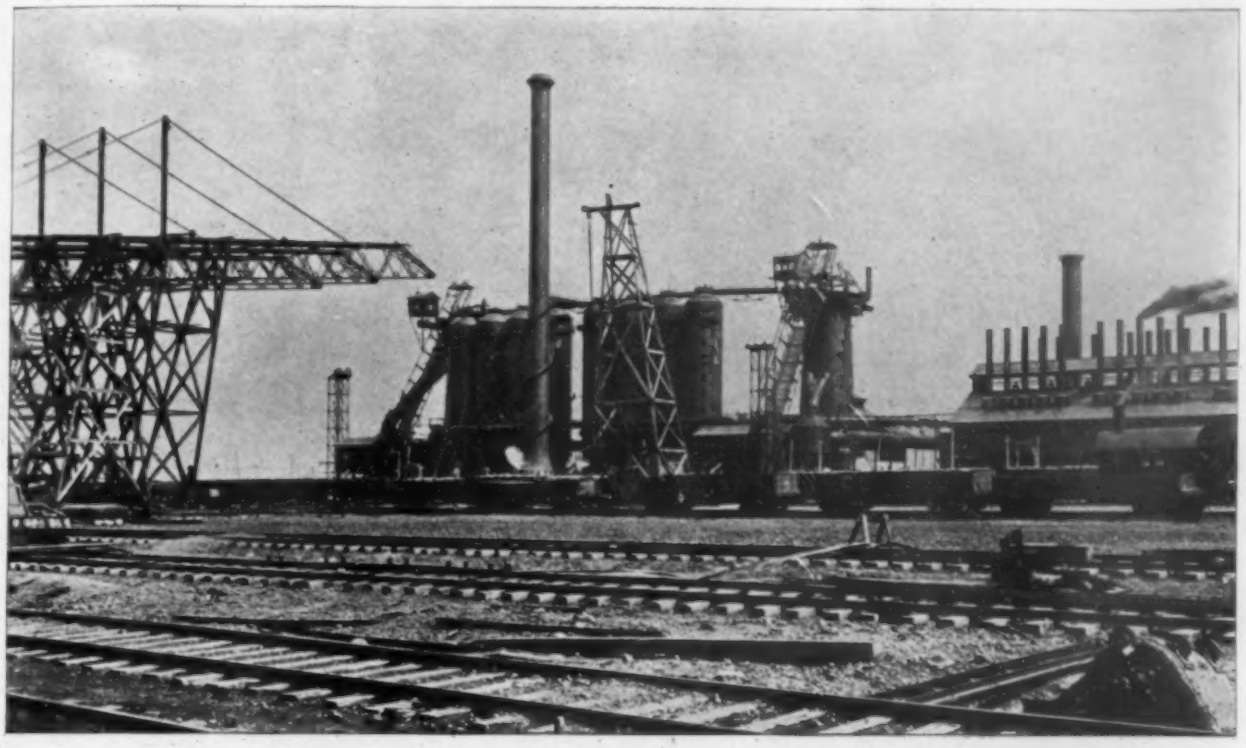


FIG 1.—LORAIN STEEL CO.'S BLAST FURNACES—SHOWING RELATION OF ORE HOISTS AND YARD TO FURNACE YARD.

They are of steel construction except the bottom, which is of cast iron plates. The ore carrier runs in the pit, which is on the right of the bins, as in Fig. 3, the girders supporting the track on which the car runs being six feet below the surface. The car has a bucket suspended from it by frame work, and this bucket empties into a skip which carries the stock to the top of the furnace. Details of this, as of the other features of this splendidly equipped plant, including the pig iron casting system devised by Manager Max. M. Suppes, are given in the descriptive article referred to above. The furnaces are under the management of Mr. Willard Fuller.

A. A. Lawrence, Buffalo, is proprietor of the King Iron Works Brass Foundry, which is in the same building occupied by the King Iron Works and does all the latter's work in brass and bronze. Mr. Lawrence has worked in these specialties for 33 years. His products include tempered copper commutators, brass for electrical work, brass patterns and molded work, propeller wheels from 15 pounds to 5 tons and general brass jobbing work.

The West Second Street Foundry, Davenport, Ia., is under the proprietorship of Harry J. Frank. The products are light gray iron castings, stove repairs, grate bars, and general castings. The plant has been quite full of work for some time.

MODERN BLACKSMITH SHOPS.

BY S. H. STUPAKOFF.

Some time ago I ran across an item in one of our well-known daily papers, which stated that no material improvements had been made within the last 300 years in the equipment of blacksmith shops. Those readers who always believe what they find in black and white are therefore convinced that the art of blacksmithing was taught us by Tubal Cain in the old Biblical times and handed down from generation to generation of our forefathers without much progress, except such as it underwent in medieval times. If such an item had been written by an engineering paper, there is no doubt that it would have caused great revolt and controversy among its readers, as such papers are supposed to give reasons for assertions of this kind. The question is, however, sufficiently interesting for investigation, so that we may give, if possible, some reasons and examples which will prove the contrary.

We must admit that by comparing the present common country blacksmith shop with one of 300 years ago, we will doubtless find but little advancement in its general arrangement and equipments. The forge, the bellows, hammer, anvil, and tongs are to-day the same and have hardly undergone a change in shape, but by carefully looking around us, we find

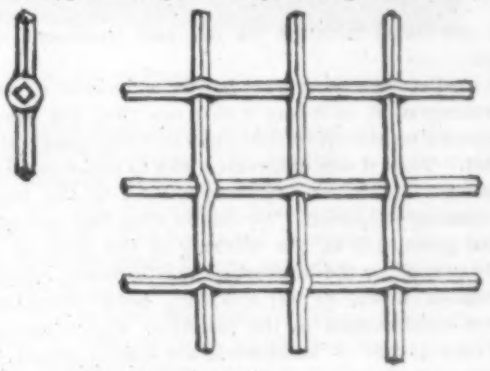


FIG. 1.

in the shop of our time this difference: a quantity of iron rods of different dimensions are stacked up, which would be missing in the medieval smithy. At the horse-shoer's we find also a number of half finished horse shoes of different sizes hung up on the walls, or under the roof, or, it may be, packed in

kegs ranged alongside others filled with horse nails and various finished material of different descriptions.

These few articles here enumerated were formerly a direct product of the smithy, which then produced a number of things not made in our present blacksmith shop, and they must therefore be a part of special branches of the iron industry. This, as is well known, is actually the case.

Antiquity of the Blacksmith's Art.

Originally, or I should say, until only a comparatively short time ago, the making of the iron itself was part of the work of the blacksmith. It is known that this art was practiced thousands of years ago by the Assyrians; this has been proved by the discoveries of Laird at Nineveh, of saws, knives, and other tools, which are quite similar to those of our present time. But it was not only known in the old days how to make the iron, it was also known how to produce steel, and it was well understood how to work, handle and harden it. The Greeks were also familiar with the art, as Aristotle, Plinius and Galen mention its use and treatment in their writings.

Until medieval times this art hardly underwent any changs, rather retrograded, as it was in this age that the knowledge of the special treatment of the celebrated Damascus steel became lost. Then it was discovered how to make cast iron and iron castings, which were apparently used in the beginning for the making of cannon. We cannot deny that our ancestors possessed great skill in the working of the iron, as is conclusively proved by the numerous masterpieces which have been handed down to us; and this, notwithstanding that they were handicapped by the primitive appliances then in use. These pieces of handiwork are highly prized by our museums and exhibitions and are valued not only as triumphs of mechanical skill but are also recognized as distinctive artistic creations.

I remember seeing among other specimens in the Hradshin in Prague, a gate, which must have been made in about the 15th century, which would puzzle any blacksmith of our day if they were asked to duplicate it. It was a network of iron rods, interwoven one into the other, of which each mesh required at least two welds. The meshes were approximately 2½ inches square, the rods about ⅝-inch and the grating over all about 7 feet square. Fig. 1 gives an illustration of a small portion indicating the design.

Changes in Methods of Iron Production.

As to the production of iron itself, our present practice varies very much from that followed in former years. It has actually undergone a complete revolution within the latter half of this century. New industries have sprung up since the introduction of rolling mills, which latter interest has grown largely within comparatively few years; in fact, within the memory of the writer. And, though the rolling mill is no part of the blacksmith shop, it undoubtedly replaces the hammer and anvil, which were the only tools used formerly for accomplishing the same results.

If we should trace the products of the rolling mills, we would learn that they find their way into various establishments and undergo further manipulations. And all these large factories can be traced back likewise to the original blacksmith shop from which they were gradually developed. While formerly all iron was worked and finished in the blacksmith shop, the shop itself is to-day only a small, though not a less important, part in the plants for the manipulation of iron. Among others, we count under the larger iron industries machine shops, boiler works, ship building establishments and bridge works. Each of these branches admits naturally, special requirements, and each is accordingly equipped with tools which suit its particular case.

The steam hammer, invented by Nasmyth in 1842, has superseded the sledge hammer in nearly all large manufacturing establishments. And it is used with the greatest economy and with best success in the production of the numerous articles of manufacture, from the largest to the smallest parts, such as shafts for ocean steamers, cannon, etc.

The model of the large steam hammer exhibited at the

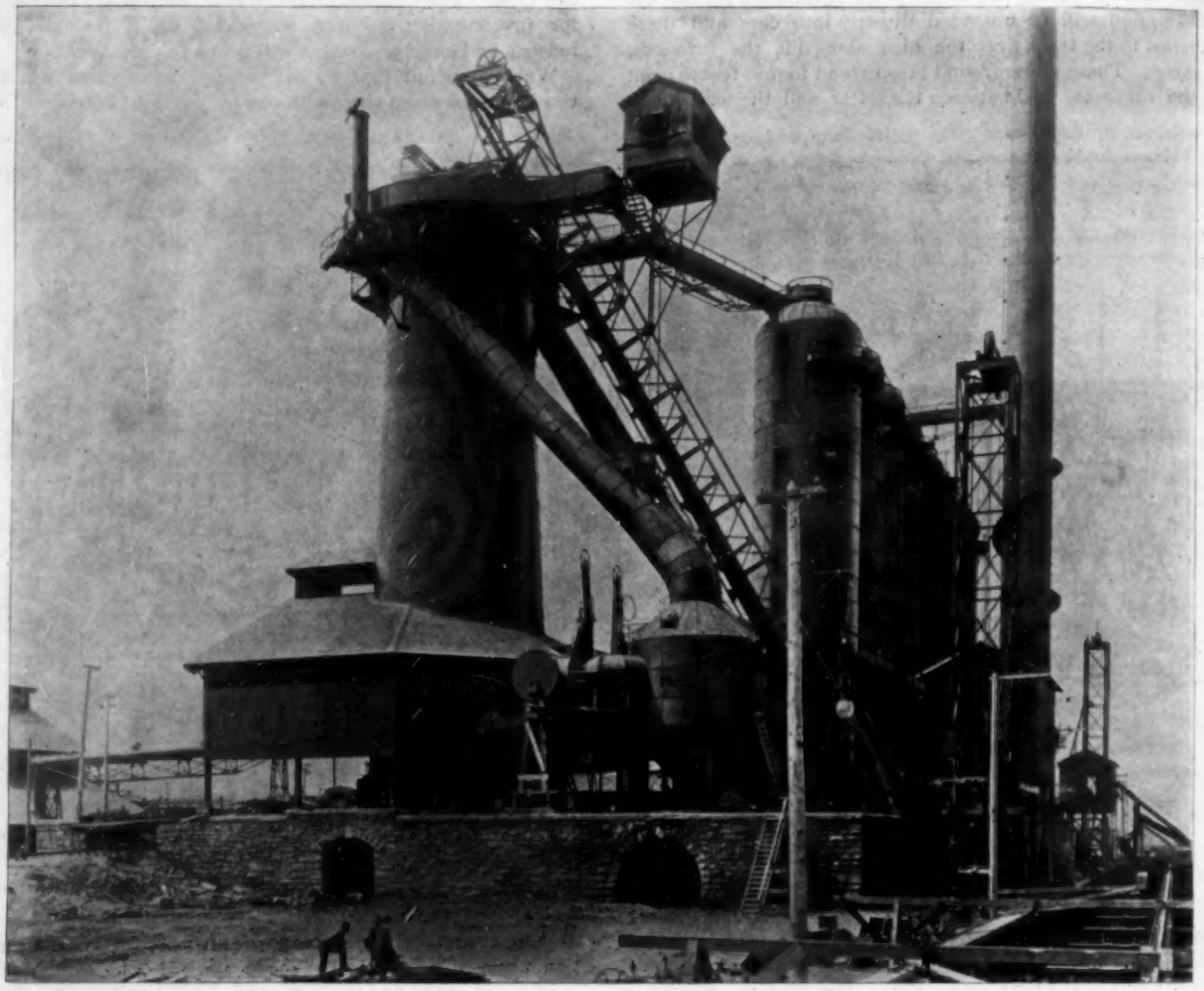


FIG. 2.—VIEW OF LORAIN STEEL CO.'S FURNACE NO. 1., WITH HOIST, STOVES, STACK AND A PORTION OF BIN SYSTEM.

Chicago Exposition by the Bethlehem Iron Works will remain in the memory of all who have seen it. Other large hammers of this description are the Creuzot of 80 tons, Perm of 51 tons, the Krupp and the Alexandrowsky of 50 tons each, Woolwich of 35 tons, and at Armstrong's of 30 tons. These large hammers are naturally constructed to suit existing requirements, and in their details they vary accordingly quite considerably.

Hammers of Various Forms.

Steam hammers are only a small fraction of the labor saving appliances used in our blacksmith shops of to-day. In a great many cases it is preferable to use spring hammers, drop hammers, helve hammers and special forging machines. Drop hammers are used especially for the production of forgings en masse, which are made not only from iron, but also, in late years, from copper. I remember seeing about 30 years ago, certainly over 25, some arrow heads for fence posts which were made by this process. These, I was informed on good authority, were made in Westphalia, Germany. They were equal to the best drop forgings of to-day.

The first helve hammer which I saw actually at work, about 18 years ago, was used for the making of bolt heads during the construction of the Lietanya (Foundry) bridge, in St. Petersburg, Russia. This was a very primitive piece of machinery if we should compare it with our present bolt header, though there is no doubt that this machine furnished more work than two or three good blacksmiths with their helpers could make. The appliance is easily described as consisting of an anvil block with cast iron dies in which a pin moved loosely and was worked by a lever underneath up and downwardly, the purpose of which was to knock the bolt out of the dies after the head had been finished by the upper portion of the die, which formed part of the hammer block. The latter was fastened on to a flexible wooden beam, to which a rapid up and down motion was imparted by a connection with the main shaft. The heads of the bolts were in this case upset, which is also the case in the modern heading machines, and contrary to the former method of welding a ring upon the end of the bolt which was first upset for the purpose.

The Modern Bolt-Heading Machines.

One of our modern bolt-heading machines compared with tihs primitive piece of machinery gives positive evidence that the blacksmith shop has not been at a standstill in this direction within the latter half of our century.

Frequent opportunities are offered for seeing such bolt-heading machines at work in numerous plants of our manufacturing centers. It will be found in these that two half dies are arranged horizontally which open and close during the running of the machine. The heading tool is advanced toward the material, which has been gripped in the meantime by the two half dies, and motion is imparted to the same by a strong crank-shaft. The bolt head is made in this manner usually by a single stroke of the machine. The small machines are run by boys, who sit on a stool in front of the machine and have ranged alongside of them especially constructed heating furnaces from which they take the piece of iron, which previously has been cut to the proper length. Other machines are so arranged that they will make the bolt directly from the bar, without being cut off to length, and in this manner several bolts can be made with one heating of the bar. Most modern heading machines are constructed in this way. The principle is at any rate the same as that of the one described above. With their aid it is possible to manu-

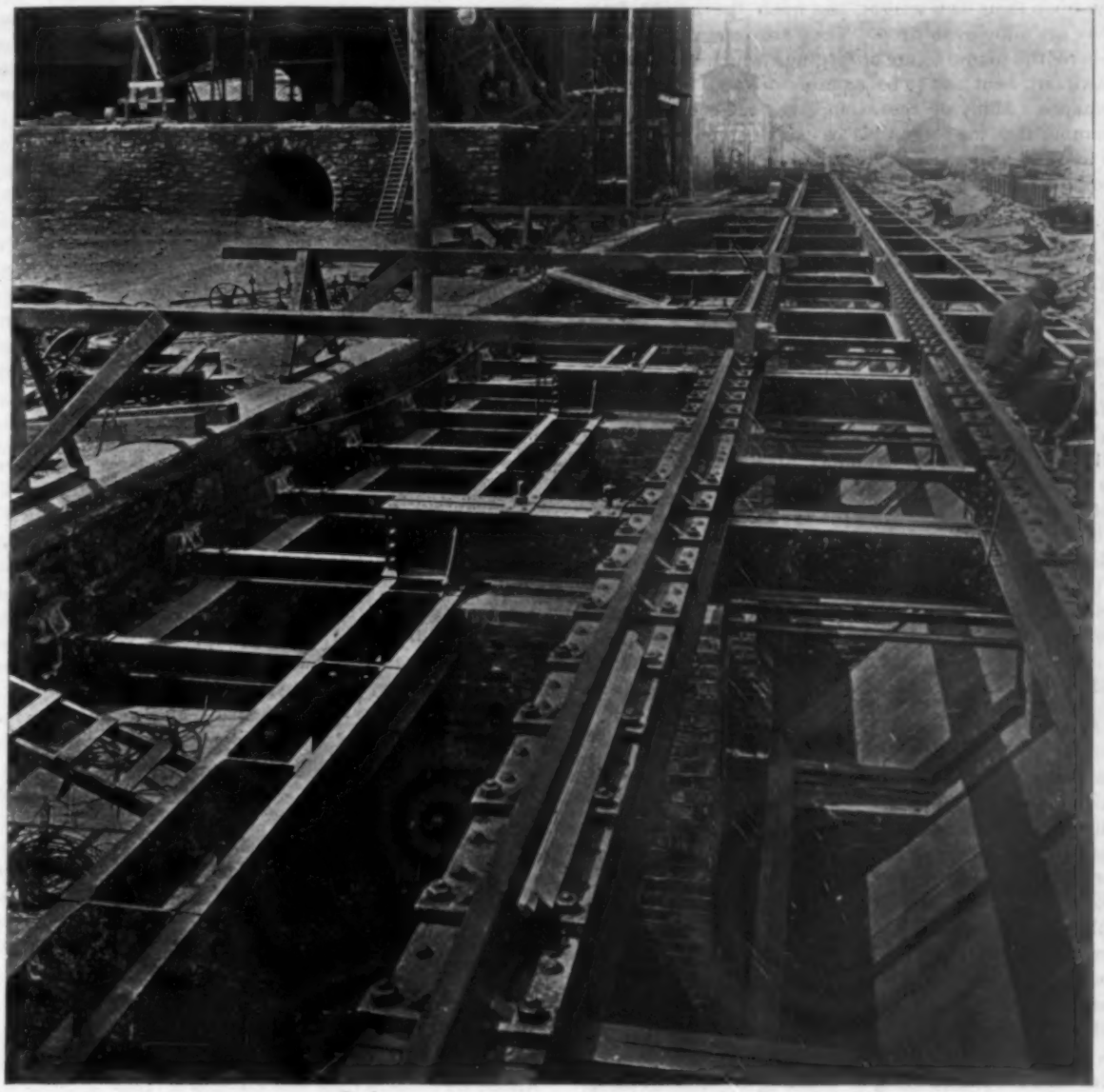


FIG. 3.—LORAIN STEEL CO.'S FURNACES. VIEW OF BIN SYSTEM.

facture forgings of a greater variety of shapes and in a small fraction of the time it would be necessary to produce the same by hand over an anvil.

The method of working the material is limited in these machines almost exclusively to an upsetting process of the material, and the majority of forgings in which this process is admissible can be produced on this machine with more or less ease and with considerable saving of time and expense, when compared with forgings produced on the anvil.

Drop Hammer Work.

For the production of forgings of another class, drop hammers of different construction are made use of, in which the hammer block is raised to a convenint height by levers, ropes, springs, friction boards, or steam; and thereafter, by suddenly disconnecting the same, permitted to drop on the piece of work. The effectiveness of these hammers depends, naturally, upon their own weight, and upon the height from which they are allowed to drop. They are especially largely applicable for the manufacture of forgings which are required to be drawn out, bent and to be suitably pressed in forms of various shapes. Many of these machines are constructed in such a manner that the forged pieces can be given a number of blows in quick succession, while in other cases a separate operation by hand is required for each blow struck with the machine. However, there are also such machines in which the working piece can be given, according to requirements, several blows in quick succession, or single blows, if necessary. Machines of the latter description are naturally in many cases preferable to others.

While a few decades ago drop hammers could be found only in single instances, they are to-day much used tools; and there are factories which use these machines in great numbers, in fact, make a business of furnishing forgings produced exclusively with their aid. A modern drop forging establishment will show two rows of hammers arranged lengthwise, with the intermission of necessary trimming presses for cutting of burs left by the dies during the process of forging. In front of these drop hammers, that is towards the sides of the building, are ordinarily arranged the necessary furnaces, likewise in rows parallel to the hammers. The whole represents a picture which will without doubt compare more than favorably with the blacksmith shop of the 17th century, and it gives us excellent proof that the assertion of the authority (?) quoted in the above mentioned daily paper must have been made in ignorance.

Modern Bending Machines.

But the modern blacksmith shop is not complete if it is not equipped with suitable bending machines, which, as their name indicates, are less used for forging than for the bending of articles which have previously been shaped into the required forms. They are here generally known under the name of "bulldozers."

Hydraulic forging machines, or hydraulic presses, are used for the production of special forms; for instance, the knuckles for car couplers, locomotive wheels, car wheels, brake beams, etc. Most extensively however, they are used for the bending of boiler heads and for the production of the various parts of boilers, as domes, flanges, manholes, manhole covers, etc., and besides this, for the bending or pressing of parts of cars, hollow ware and armor plates.

Likewise it is easy to trace back to the blacksmith shop all modern machinery for cold-pressing, bending and swedging; with the aid of which the largest quantity of wire nails, small rivets, staples, screws and other small articles are produced, though at the present time certain classes of these articles are considered as products of special branches of the iron and steel industries. The extremely difficult shapes of bicycle parts and numerous other articles are now made in the same or in a similar manner by cold-pressing or swedging. While only a few years ago they were products of the blacksmith shop.

It would lead me too far should I here enter into a detailed description of the construction and manipulation of all or even a few of these machines. These subjects offer an extensive field for a series of interesting articles, which may be taken up by specialists of the different branches. While very little of the work described in the above is now done in the blacksmith shop proper, it cannot be denied that all these productions belonged originally within the realm of blacksmithing; an art, which undoubtedly has been developed to an exceptionally high degree, and which has borne more fruit than any one of the other industries.

Heating Furnace Manufacturers' Association.

A meeting of manufacturers of heating furnaces was held in Cleveland recently for the purpose of organizing an association in the West, similar to the one already organized in the East, the object being to reform as far as possible abuses and unprofitable methods which have crept into the trade as the outcome of active competition. Unlike nearly every other branch of the trade, furnace manufacturers of the West have gone on the basis of every man for himself, and have had no trade organization. It is not proposed to form a trust or a combination, or any consolidation of capital, but it is hoped the new organization will bring about uniform customs in the making of contracts, shipment of goods and terms of payment; to abolish the selling of goods on consignment, and other things of this nature which can be agreed upon without interfering with individual control and management of each business. There will be the same competition as before, but the aim is to confine it to two main features, viz.: price and quality, and to use uniform methods in other things. The officers of the new association, which is named the Central Furnace Manufacturers' Association, are: Geo. Peck, of the Peck-Williamson Heating and Ventilating Co., Cincinnati, president, and H. H. Whiting, of the Bonnot Furnace Co., Canton, O., secretary and treasurer. These two with Messrs. May, of May & Fiebeger, Akron, O., Snyder, of Hess & Snyder, Massillon, O., and Patterson, of the Patterson Furnace Co., Erie, Pa., are the executive committee.

Manning, Maxwell & Moore in New Quarters.

The firm of Manning, Maxwell & Moore, and its kindred interests, the Ashcroft Manufacturing Co., the Shaw Electric Crane Co., the Consolidated Safety Valve Co., the Pedrick & Ayer Co., and the Hayden & Derby Mfg. Co., has had its New York offices and salesrooms for a great many years at Nos. 111 and 113 Liberty st. It has now removed to the new Singer Building, 85, 87 and 89 Liberty st., corner of Broadway. The change has been found necessary owing to the steady increase of business done by this firm. The new quarters are large, commodious and convenient, and arranged to meet the situation fully. The ground floor will be devoted entirely to show rooms and has facilities for carrying a complete stock of everything pertaining to the business. The first floor will be occupied by the business offices which are fitted throughout with the most modern appliances to permit of handling the large volume of business most conveniently, economically and expeditiously. A central telephone desk or exchange, has been established which will give the firm direct telephone connection with all of its factories and with every department of the business.

Greaves & Klusman, of Cincinnati, have just awarded a contract for their new building to be erected at Cook and Alfred sts., where they will operate a large modern machine shop. The building is expected to be ready for occupancy about July 1, and will have 20,000 feet of floor space, about doubling the present capacity of the plant. This firm has occupied its present quarters, 227-229 W. 2nd st., for ten years, turning out a line of wood working machinery, but recently it has put a new 16-inch engine lathe on the market and proposes to add larger size lathes in the near future, giving special attention to the manufacture of these tools. Additional tools have been purchased recently, including a gear cutter from Gould & Eberhardt, and a Gray planer, and other tools will be needed to fit out the new plant.

The sixth annual oyster roast of the Berlin Bridge Co., East Berlin, Conn., was given to its employes and their families on Wednesday evening, April 26. These functions have been a feature of the shop year at East Berlin, and have been carried out by the company on a scale of characteristic liberality. The invitations were of artistic design.

FLUOR SPAR DEPOSITS IN KENTUCKY.

BY DR. RICHARD MOLDENKE.

Of late the iron industry has become interested in a mineral which was formerly much used for fluxing purposes. High prices, uncertain delivery and only spasmodic efforts to market the fluor spar had long stopped its use in furnace and foundry. The gradual opening up of our native deposits upon systematic lines and a production in excess of the drafts made by the glass and chemical industries soon sought out a new field in the replacement of the less powerful fluxing agent, limestone.

Fluor spar, also known as Derbyshire spar, is a mineral fluoride of calcium found in nature in a more or less pure state. Usually compact, it is nevertheless subject to the laws of crystallization, and wherever local conditions have been such that the crystals could form freely magnificent suites of brilliant white, yellow, rose, red, violet, blue and even green crystalline formations were the consequence. Sometimes a crystal is found which shows both the blue and the green color, and this property is called fluorism; then again the mineral becomes fluorescent under the influence of heat and light and remains so for some time after. The ancient Murrhina vases were of this beautiful material, and to-day Derbyshire spar ornaments are quite common in England.

The usual crystalline form of fluor spar is the cube. This is plainly shown in a number of specimens of the pure white variety found by the writer in one of the mines of the Kentucky Fluor Spar Co., whose extensive holdings he had the pleasure of examining professionally a year ago, and the general aspect of which, through the courtesy of the owners, is here presented. Other forms are based upon the cube, the octahedron, and combinations which give quite complex forms. Then we have distorted and twin crystals in variety.

Fluor spar sometimes resembles the emerald and the amethyst, but is very much softer and more friable than either. The requirements of good fluor spar are almost absolute freedom from silica, iron, clay and lead. This brings about a commercial grading of the product into the best spar for acid and glass works and the second quality for fluxing purposes. The former is ground up fine and the latter remains in lump. Naturally every producer aims at getting as much of his product into class No. 1 as possible, and here modern mining and ore dressing methods find a good field of application. A third class is practically much galena with little fluor spar, and is jigged to separate the two, the fluor spar saved going into the second class and the galena to the smelters.

The use of fluor spar is confined to very few industries; the manufacture of hydrofluoric acid; in glass making to obtain opalescent effects; for paint enamels of certain kinds; in the reduction of aluminum; for mineral wool, and as a flux in steel and iron melting.

Fluor spar is found widely disseminated in nature, but comparatively little is available, for it is either too far from the railroads, or is in thin veins and impure at that. Shipments from Newcastle, England, supply the eastern markets, while almost the entire domestic prodution is centered at the border line of Northwestern Kentucky and Southern Illinois. New York, New Mexico, California, Colorado and Arizona furnish a little, and there are said to be excellent deposits in Austria, but of them little finds its way into the active American markets.

As practically all the fluor spar mined in the United States comes from the Kentucky-Illinois section, and it occurs here in greater abundance than at any other known spar locality in the world, the local geology will be interesting. The vines of fluor spar seem to follow the lines of faulting in the carboniferous series. They are practically all found in the limestone which underlie these measures; occasionally the walls are of sand stone, but usually at least one wall is limestone. The faulting must have been very extensive, for veins of fluor spar seem to be everywhere, and surface mining is one of the regular occupations of the Kentucky farmer when he needs money. The spar thus found, however, is weathered and contaminated by a little iron and more intercrystalline mud.

From the genesis of fluor spar as outlined by Dr. Emmons we can understand many of the peculiar phenomena observed underground in the vein structure. The supposition is that all limestones contain, besides the vast preponderance of carbonate of lime, small but appreciable amounts of the fluoride. Some limestones carry in addition traces of the sulphides of lead, iron, copper and zinc. With the iron there is associated manganese which is supposed to give the beautiful amethyst color to the spar. At Rosiclare, Ill., there are more of the latter impurities in the spar than at Marion, Ky. In the process of formation calc spar was deposited in the faults and fissures first, then fluor spar began to replace it, sulphide of lead replacing this, and finally sulphide of zinc coming last. The whole process can be seen in the various stages underground, the action being arrested the moment the current of water was suddenly stopped by the plugging up of some outlet by the settlement of clay.

The foot wall, which at Marion is of limestone, as well as the hanging wall, usually has more or less calc spar adhering to it, though in many places fluor spar is the order from wall to wall. The hanging wall is cracked and slivered continually. Very frequently a large flat sliver can be traced distinctly, being imbedded entirely in fluor spar. Usually this means a narrowing of the vein just below a very wide spot from which this sliver of rock evidently came. The dissolving action of the water has often completely destroyed this rock debris coming from the hanging wall, and then again whole series of smaller pieces remain which make it difficult to ascertain just where the real hanging wall begins. Nearly all the lead is found in a narrow ribbon near the foot wall, which enables a quick dressing of the mineral underground if desired.

As the purpose for which the fluor spar is to be used has a great influence upon the ore dressing methods employed, a close examination of the vein matter is very desirable. Thus the shading off of fluor to calc spar makes it necessary to reject much of the mineral for acid making purposes, for any calc spar present means a loss of sulphuric acid in the preparation of the hydrofluoric. Again, such a piece containing both spars developed, upon analysis, the presence of 8.92 per cent of silica, which alone would condemn it for making acid. A piece of surface spar contained 0.23 per cent silica, which is still high, and a piece of the finest white spar gave 0.07 per cent silica, which is practically only a trace.

This brings us to the question of mud pockets, which have proved disastrous at Rosiclare. Only the most careful system of drifting and sinking so that regular and comparatively small sections of stoping ground be blocked out well ahead of the daily winning operations, will prevent disastrous floods at most inopportune times. By keeping the levels near together such a body of soft mud may be tapped near the top instead of at the very bottom and the mine kept open.

The whole region abounds in sink holes, through which surface waters enter and flow about in subterranean streams which may be unnoticed for miles only to come out at some low spot in the shape of a cold, clear spring issuing from a fissure as round as a barrel. Where the fine clay of the surface has closed such a sink hole, we have a circular basin which may hold rain water all the year round.

A study of the country lime stone shows us the reason for this, the ingredients being the following:

Carbonate of Lime, ...	79.	per cent.
Alumina, ...	2.6	"
Silica, ...	8.4	"

Recalculating we have: carbonate of lime 79.0 per cent, clay 5.66 per cent; sand 5.34 per cent. This, then, explains why we have sand and clay in this purely limestone region, and also why we actually find surface veins of fluor spar standing out alone above the limestone walls. Furthermore a disintegration of such exposed veins and a washing together of the pebbles into regular beds gives us the well known deposits of "gravel spar" sold for fluxing purposes. An assay of the Marion galena showed but ¼ ounce silver to the ton, so that it does not pay to collect the very small quantity available.

As stated above there are a number of veins of fluor spar in evidence at Marion, Ky., the main deposits running N. 37 degrees E. Another series of veins run N. 5 degrees E. Still a third set of veins run N.W. and S. E., but dip in the opposite direction from all the other veins of the region, and may

be the result of exceptional faulting or the cracking off of a top heavy section of the limestone formation.

The mining of the deposits shows up all these peculiarities, for the vein continually widens and pinches, sometimes stopping altogether for some distance. There is, however, every reason to believe that the supply of spar will be at least as deep as the limestones of that geological series, that is, some 1,000 feet. Below this the solubility of the succeeding limestone formations will determine the thickness of the deposit —the easier this limestone is dissolved the thicker will be the spar.

At the time of the examination there was enough drifting completed to block out 8,000 tons of fluor spar for stoping. The character of the vein, as far as it was traced by test pits justified a prediction of an available supply of spar which would dress up 90 per cent of No. 1 of 500,000 tons, and this only on one vein, many of the others being located but not tested as yet.

The most profitable system of mining is by sinking shafts along the inclination of the veins. This may change slightly as it goes down, but is always quite steep. Cross drifting at short intervals, and then overhead stoping. A rough dressing of the spar can be effected underground and save much unnecessary hoisting. While there is much water in the veins, the hoisting buckets can take care of it, and unless some underground water course is struck no pumping facilities need be installed.

The spar comes up to the surface covered with mud and is here washed at once. Next it is sorted and the impure pieces go the flux pile, while the fine white variety is stored in bins, there to dry and be ground up subsequently in burr stone mills. The first quality of spar is ground up very fine and shipped in barrels; the fluxing material goes in bulk, or, if it be "gravel spar" is also barreled to prevent loss.

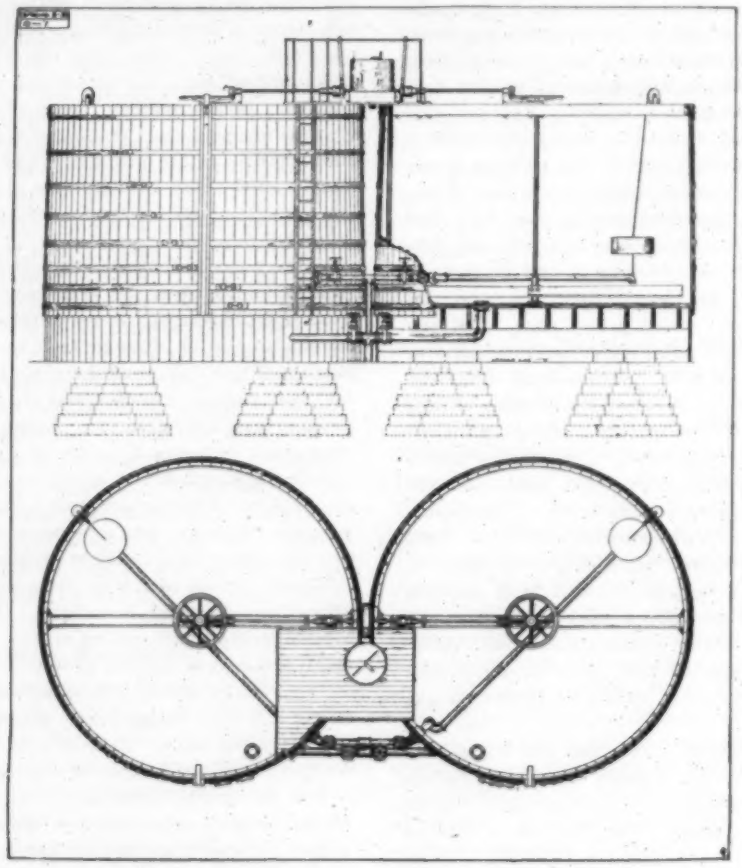
At the present time nearly all the spar sold comes from this region, and while excellent mining facilities are being provided, the demand is still far ahead of the supply.

THE stocks in the yards of the American Pig Iron Storage Warrant Co., on April 30, were down to 86,500 tons, there having been withdrawn in the preceding ten days 9,800 tons, and none put in. On April 30, 1898, the total in the yards was 270,600 tons; in 1897, on the same date, 216,900 tons; in 1896, 108,100 tons.

WATER SOFTENING PLANTS.

The advantages of water softening are not generally understood or appreciated in this country. The process was discovered nearly 60 years ago by Dr. Clark, of Aberdeen, Scotland, and since that time it has been extensively adopted in England, not only for softening the water supply of towns and cities, but also for the various requirements of the mechanical arts. Hundreds of water softening plants are in successful daily use in Great Britain, France, Belgium and Germany. The mechanical features of these may differ according to the ideas of the designer, but all make use of the same chemical process. These plants are softening water for steam boilers, railways, woolen and cotton mills, paper mills, iron and steel works, dye works, tanneries, etc.

The common mineral impurities soluble in water are silica, iron, carbonate of lime, and magnesia, sulphate of lime and magnesia, and chloride of lime and magnesia; also the chlorides and sulphates of soda or potash. The lime, magnesia and iron salts are known as the scale-forming impurities and are the ones which are removed by water softening. At the same time these are removed, the mud or salt which the water may contain is also eliminated, and the organic matter reduced. The sodium and potassium salts do not form scale, and are not removed by this process. Neither is it possible to do so by any process of purifying water, with or without the aid of heat. The only means of removing sodium or potassium salts from water is by distillation; this is the process which takes place in the boilers. The lime and magnesa salts are held in soluton by means of the acids with which they are united. Water softening, therefore, is a process of removing from the lime and magnesia these acids which hold them in solution.



PLAN AND SECTIONAL VIEW OF WATER SOFTENING PLANT.

The expense due to softening water is extremely low, because, 1, the carbonates are generally more abundant in waters than the sulphates or chlorides. 2. The Clark process will remove a higher percentage of carbonates than any other method, which would be practical and economical enough to use for industrial purposes. The precipitating process which takes place during the removal of the incrustating solids reduces the organic matter, and removes bacteria; thus a sanitary purification is brought about at the same time the water is softened.

The following table is copied from the report of W. J. Dibdin, chemist for the London County Council, who conducted

a series of experiments on water of the New River company:†

DATE.	Before Softening.		After Softening.		Percentage of Reduction.	
	Hardness.	Bacteria.	Hardness.	Bacteria.	Hardness.	Bacteria.
December 16, 1895.....	17.4°	96	5.4°	12	68.4°	87.5
December 18, 1895.....	17.4°	110	5.0°	6	71.3°	94.5
December 20, 1895.....	17.4°	60	8.5°	16	51.2°	73.4

Hardness is expressed in degrees, Clark, and bacteria given in colonies per cubic centimeters.

The treatment reduced the red color in the water 100 per cent and the yellow color 35 per cent. No change in free ammonia was found, but albuminoid ammonia was reduced 23 per cent, and the oxygen aborbing power in the four hour test was reduced 25 per cent. Mr. Dibdin says: "It will therefore be seen that by the adoption of a system of softening the present supply, in respect to chemical quality and bacteria it would be improved to a degree comparable with that of the Welch sources."

The most approved method for softening water is known as the intermitting settling tank plan, in distinction from the continuous method of purification, in which the water is always moving, and is purified in transit. Where the quantity of water required is comparatively small, more satisfactory results are obtained by using the intermittent settling tank plan. The apparatus consists of two or more open tanks, or one tank and a storage reservoir. These tanks may be constructed of wood or iron, as is preferred. They are generally made cylindrical, and usually located out of doors, convenient to the boiler room. This has the adavntage of not crowding up the boiler room, while there is no danger of the water in the tanks freezing while the plant is in daily use. The size of the tanks depends upon the quantity of water required per day, and the number of times it is convenient to fill them. Each tank is placed upon a heavy platform carried upon foundation piers, and is provided with a mechanical stirring device to be used in mixing water with chemicals. This stirring device consists of a paddle revolved by the simple gearing turned by hand, or preferably by light power. This paddle stirs up the lime sludge of previous precipitation, from the bottom of the tank; this floats in the water and hastens the chemical reaction and causes the finely divided precipitate to gather into large flocculent or woolly flakes, which settle quickly as soon as the water stops moving. The apparatus does not have to be cleaned to keep it in working condition. It requires from ¼ h. p. to 3 h. p. to operate it, so that the amount of steam is extremely small.

The softened water after settling is taken from the tanks by means of a hinged floating outlet pipe, which rises and falls with level of the water. By this means the clearest water is always drawn from the top of the tank. Inlet connections through which to fill the tank, and wash pipe connections through which to wash lime sludge from tanks are placed in the bottom. The washing of the settling tanks need only be done when lime sludge becomes deep enough to interfere with stirring; ordinarily once a week or a fortnight is sufficient. All that is required is to open wash valve, start the stirring device, and mix up the lime sludge with the water, which is always left in the bottom of the tank for it is soft enough to run out through the wash pipe. The time and labor of cleaning is but a small percentage of that required for exhaust or live steam heaters, and it is not necessary to do the work on top of the boilers in a hot stifling atmosphere. A sheet iron settling tank is placed on top of the settling tanks; in this are placed the reagents used for softening. They are mixed with water and washed into the tanks while filling.

Inasmuch as it is not practical to use settling tanks having capacities sufficient to permit the water standing long enough to clear itself perfectly, the manufacturers advocate passing the water through a mechanical filter, merely to clarify it by removing the floating lime sludge. For this purpose gravity or pressure filters are employed and a sand-bed used as a filtering medium. By this means clear, soft water is obtained.

There are 23 water softening plants in this country, erected in accordance with improved plans. These are furnishing softened water for ice factories, dye works, laundries, electric light plants, street railway power houses, paper mills, public institutions, steel works and various manufacturing concerns. Some of them have been in daily use for over three years, and all are giving satisfactory results. A recent installation was for the Lorain Steel Co., Lorain, O., and was made by the We Fu Go Co., of Cincinnati, who control in the United States the Clark process referred to in the above.

†Analytical investigations of London Water Supply, London County Council, January, 1896.

PERSONNEL.

Of Various Iron and Steel, Machinery and Supply Interests of Chicago.

There is no better index to Chicago's importance as a trafficking center for all departments of iron and steel manufacture, power equipment and machinery and supplies, than such a list as the following. It contains the names of many of the leaders in the lines mentioned, and is expressive testimony to the activities that have advanced Chicago with rapid pace to the splendid position it has taken as a manufacturer and distributor of iron:

D. A. Stuart & Co., with factory at 447-453 Illinois st., manufacture oils and lubricating compounds.

Munox & Darley, offices in The Rookery, are general Western agents for the Cahall and Babcock & Wilcox water tube boilers, manufactured by the Aultman & Taylor Machinery Co., Mansfield, O.

The Chicago Chain Works, composed of S. G. Taylor and S. G. Taylor, Jr., forming the firm of S. G. Taylor & Son, manufactures and markets chains for all uses. The plant is located at 98-100 Indiana st.

The R. M. Eddy Foundry Co.'s works and offices are at 43-61 Indiana st. Geo. D. Eddy is president, and A. M. Eddy, secretary and treasurer. The firm was established in 1865. Its products are castings for boiler fronts, machinery, etc.

The Cuprigraph Co.—This concern is located at 108 North Green st. The principal product is the sanitary still for distilling and sterilizing water.

The Ball Engine Co., of Erie, Pa., make a high speed engine for electric lighting purposes. The Chicago branch office is at 1526 Monadnock Block, W. A. Kreider, manager.

The Chicago Iron & Steel Co.'s offices are rooms 300-301 No. 234 La Salle st. It deals in iron and steel, merchandise bar and railway supplies. W. G. Bentley is manager.

The American Stoker Co., with general office in the Washington Life Building, New York, has its Chicago office at 1008 New York Life Building, under the charge of M. C. Huyett. The company's officers are as follows: H. B. Haigh, president; R. C. Peabody, vice-president and treasurer; J. Wolff secretary; H. W. Fullerton, general manager; and W. R. Wood, chief engineer.

The Wm. Graver Tank Works, Inc., with office at 790 Old Colony Bldg., Chicago, manufactures steel storage tanks.

The Reeves Iron Co. is located at Canal Dover, O., with a Chicago office at 36 La Salle st., under the management of W. C. Brown. Its products are black, galvanized and corrugated steel sheets.

Smeeth's Copper & Bronze Co.—This concern manufactures the Scott patent bosh cooling plate, copper and bronze tuyeres, coolers, tuyere holders, hot blast valves, and valve sets. It is located on the northwest corner of Randolph and Desplaines sts.

Warren, Webster & Co., of Camden, N. J., with Chicago office at 1509-10 Monadnock Block, in charge of Wm. D. Pickels manufactures a large line of low pressure steam heating appliances. The company has other offices in Boston, New York, Philadelphia, and St. Louis.

W. C. Heimbuecher, who has been connected with the iron trade for 15 years, is well-known throughout the West and Middle West. After traveling over this territory for eight years while in business with his father at St. Louis, he opened offices in Chicago in 1896, and is now at 36 La Salle st., with offices Nos. 209 and 210. Besides himself there are two representatives of the business on the road. He represents the Struthers Iron & Steel Co., Struthers, O.; the Falls Rivet & Machine Co., Cuyahoga Falls, O.; Franz Krein Mfg. Co., of Marion, Ind.; C. Hager & Sons Hinge Mfg. Co., St. Louis; and the W. A. Wood Harvester Co., of St. Paul. He is also sales agent for manufacturers of springs, axles, bar iron and steel, nuts, bolts, single trees and neck yokes, wagon and carriage bent wood work and cold rolled shafting.

S. Wilks Mfg. Co., manufactures the Wilks' water heaters, tanks and steam generators for all purposes for which hot water or steam is required. The officers are N. S. Bonton

president, and E. H. Sedgewick, treasurer and general manager. The concern is located at 53-55 Clinton st.

A. Plamondon Mfg. Co.—This company manufactures all styles of machinery for transmission of power. The officers are C. A. Plamondon, vice-president, and Geo. Plamondon, secretary and treasurer. The plant is at 57-67 So. Clinton st.

New York Leather Belting Co.—This concern manufactures the "Victor" oak tanned leather belting and lace leather. The factory is located in Brooklyn and there are offices in New York, Boston, New Orleans, Cleveland, and Chicago at 51 So. Canal st.

The Rudolphi & Krummel machine works were established in June, 1892. Both partners were Eastern men and had long held responsible positions under the largest firm of press and sheet metal tool builders in that section. They manufacture presses and dies, special metal and wire working machinery, and tools for bicycle manufacturing. Their foreign trade is large. Works are at 96-100 North Clinton st.,

H. W. Johns Mfg. Co.—This company, with Chicago office at 240-242 Randolph st., deals largely in asbestos for packing, pipe covering, etc. Other offices are in New York, Jersey City, Philadelphia, Boston, and London, Eng.

The Chicago Fire Proof Covering Co.—Within the last few years asbestos coverings have been greatly developed and are now used in many ways. The Chicago Fire Proof Covering Co. has been prominent in this development and there has been a rapid expansion in its business. The company manufactures all styles of sectional pipe and boiler coverings, and also puts on the market a galvanic varnish which has been recommended by the engineering department of the U. S. Navy after severe tests. Of special value in the manufacture of artificial ice is the company's brine pipe covering. The offices are at 48-50 Franklin st.

Wickes Brothers.—This concern, with works at Saginaw, E. S., Mich., manufactures stationary and marine steam boilers. W. S. Huyette, with office at 12-14 Marquette Bldg., Chicago, is contracting engineer.

Arthur J. O'Leary, with works at 132-134 W. Lake st., Chicago, does general wrought iron work and heavy blacksmithing. Work on artesian well, railway and quarry tools, frogs, crossings and switches a specialty.

The Semi-Centennial Machine & Iron Works, Philip Schwab, proprietor, are located at 286 Lake st. The principal products are pulleys, gearing, hangers, shafting, punches and dies, pumps, and engines. A specialty is made of repairing, and machines are built to order.

The Standard Boiler Mfg. Co.—This company is the successor of the Standard Boiler Co. The officers are Edwin C. Crawford, president, and S. B. McEldowney secretary and treasurer. The product is the Standard water tube safety boiler which includes the good features of existing types while including their good features with many advantages of its own. These, many manufacturers are proving for themselves. The works of the company are located at Goshen, Ind., and the sales office is in the Marquette Bldg., Chicago.

W. W. Backman.—Mr. Backman deals in coke, pig iron and coal. He represents particularly the Dayton Coal & Iron Co., and the New River Fuel Co. His office is 1208 Ellsworth Bldg.

The Carborundum Co.—The works are at Niagara Falls, N. Y., and the Chicago office is in charge of E. J. Eames, 519 Monadnock Bldg. Mr. Eames was originally in the railroad supply business and, having aided to develop the use of carborundum in shops, he has made that his business entirly. Carborundum, or silicon carbide, has superior abrasive qualities, and although the cost is more than that of older abrasives, it is coming into extensive use.

A. Finkl & Son.—This concern located at 27-29 So. Canal st., Chicago, is prepared to do general steam forging work of all descriptions. Particular attention is given to pipe and chain tongs, as well as dredge work, cranks, printing press cases, dies and brick machine knives.

The Philip Carey Mfg. Co.—The factory and general offices of this company are located at Lockland, O., the Chicago offices being under the management of the W. S. Nott Co., 113 Lake st. The firm is forging to the front through the aggressiveness of the young men composing it as well as the excellence of its products. Its asbestos magnesia pipe and boiler coverings, magnesia flexible cement roofing and roofing paints have a large sale. The company also has offices in New York, Philadelphia and other large cities.

Frederick H. Mason, 1020-21 Monadnock Block, is the Western representative of the Frankford Steel & Forging Co., whose works are located at Philadelphia and at Elmwood City, Pa. It has one of the best equipped forges in the country and works in steel exclusively. Their products are special carbon steel forgings for all purposes—crank shafts for engines, connecting or parallel rods, die blocks, heavy rolls of special steel, gear blanks, eccentric shafts, machine tool spindles, etc. Mr. Mason is also identified with several lines of power plant equipment.

Geo. L. McGregor, proprietor of the Steam Boiler Works at 244-248 So. Clinton st., Chicago, manufactures all kinds of locomotive, marine and stationary boilers. Other products are cookers and feed water heaters and tanks, and sheet iron work. Repairing is also done.

Moloney-Bennett Belting Co.—Less than two years old, this company has acquired an excellent reputation for the quality of its goods. The members of the firm are practical men and are well acquainted with the details of their business. Its lines are oak-tanned, short lap leather belting and mill supplies. Office and factory, 111-113 W. Harrison st.

H. W. Caldwell & Son Co.—The manufacturers of the Caldwell spiral conveyor have now been established in Chicago about 18 years. Their specialty is the "Caldwell helicoid" conveyor previously referred to in these columns, and looked upon with much favor by those using it. Its distinctive feature is that the flight or flange is made of one continuous strip without laps or rivets The company also manufactures general machinery and machinery for the transmission of power.

Bement & Co.—This firm is general Western agent for the Econometer, which embodies the new method of continuous illustration of combustion gas analysis. In addition Bement & Co. give attention to gas power engineering. The firm is located at 218 La Salle st.

G. M. Davis & Co.—One of the largest and best known specialty manufacturers in the country is the above firm, located at 96-100 N. Clinton st., Chicago. For 25 years they have manufactured air valves and steam gauges and now manufacture a large line of steam specialties. Their valves are well covered by patents. They manufacture the Davis valves, Davis regulator, Davis steam trap, etc. The firm bears an excellent reputation and their products have been well received.

Russell, Birdsell & Ward.—This business was established at Port Chester, N Y., in 1845. Since that time the firm have manufactured nuts and bolts of high quality, whose reputation has extended all over the country. They also have a large export trade. The plant gives employment to 500 men. F A. Mann has charge of the Chicago office, 811 New York Life Bldg.

S. J. McLeod, situated 73-77 Fulton st., Chicago, manufactures and deals in engineers' and steam fitters' supplies such as pipe fittings, brass goods, packing, hose, belting and tools. Pipe cutting is a specialty.

The Scherzer Rolling Lift Bridge Co.—One great trouble about railroad bridges over narrow, navigable streams, like the Chicago river is the difficulty about piers. This is overcome by the Scherzer Lift Bridge Co., which is constructing a bridge of this type at Campbell ave., Chicago, which will leave 120 feet clear for navigation. It will be operated by electricity. A bridge of this kind is also being constructed in Boston, and others elsewhere. Albert H. Scherzer is president of the company. The offices are at 1616 Monadnock Block.

J. L. Perkins & Co., located at 241 Lake st., Chicago, deal in roofers', tinners' and cornice makers' supplies, such as tin plate, galvanized sheet iron, steel roofing, corrugated iron, conducting pipe, eavetroughs, etc.

Chas. W. Clark is Western manager for three different companies: The Port Chester Bolt & Nut Co., Port Chester, N. Y.; Clark Bros. & Co. Milldale, Conn; and L. D. Frost &

Son, Marion, Conn. His office is at 1240 Unity Bldg., Chicago. For the past fifty years the firm of Clark Bros. & Co., of which Mr. Chas. W. Clark's father is a member, has been engaged in the manufacture of nuts and bolts of every description. Its business has had a steady growth and the firm itself has always been held in high esteem. Mr. Clark has sold the greater part of the product since 1882. The Chicago office was established in 1896.

F. R. Klemm, located at 99-101 W. Monroe st., Chicago, manufactures stone jacks, windlasses, derricks, hoisting crabs, and deals in special machinery besides doing general jobbing.

S. G. Taylor & Son.—This firm is the proprietor of the Chicago Chain Works, 98-100 E. Indiana st., established by S. G. Taylor in 1873. The products are hand made chains of all kinds with a specialty of dredge and other high grade chains for crane and elevating work. Sales have been made all over the United States, and included the chain for regulating the movable dam at Lockport, Ill. These had to stand a tensile strain of 133,000 pounds. None were rejected under test. Another specialty is high grade chains for railroads.

Daniel C. French & Co.—This concern manufactures machinery and supplies for canners and can manufacturers. It also handles tin plate, fruit cans and metals.

The Scully Steel & Iron Co.—This concern has its office and warehouse at 136-156 Fulton st. and 73-93 Wayman st., Chicago. It is the Chicago depot for Firth-Sterling tool steel. The business was established in 1891 and has so increased that it will be necessary to build a large addition this fall. The new construction will give a very complete establishment.

Chicago Boiler Cleaner Co.—A new device for cleaning water tube boilers has recently appeared and is gaining favor. It consists of a water turbine attached to the end of a wound wire hose and driven by a water pressure of 90 to 125 pounds. The arms of the turbine remove the scale in the tubes and the water washes it away. In this manner one of the principal weaknesses of the water tube boiler is overcome. The manufacturer is the Chicago Boiler Cleaner Co., 828 Monadnock Bldg.

The Buckeye Engine Co. has a Chicago office in charge of Robinson & Hunt. The office is located at 1249 Marquette Bldg. The works of the company are at Salem, O.

W. H. Lahman, whose office is at 23 S. Canal st., manufactures the Lahman-Kirkwood patent fuel saving shaking and dumping grate bar. This is made to fit any description of boiler or furnace, and burns economically all kinds of coal, notably slack and screenings. It received a medal and diploma at the World's Fair, and many enthusiastic testimonials of its value. The works are at 43-55 East Indiana st.

Geo. W. Dunne & Co., Steam Forge Works.—This concern removed April 15, to 68 West Washington st., where it has one of the best equipped plants in the state. With new steam hammers it is prepared for heavy forgings of all descriptions, such as heavy machine forgings, shafts, chain tongs, connecting rods, etc. The firm carries in stock a complete line of chisels, punches, chain tools, and pipe tongs. George W. Dunne's 14 years experience makes him an authority on tool steel work.

The Globe Iron Works.—This concern, of which H. A. Streeter is proprietor, is located 35-41 Indiana st., Chicago, and manufactures iron work of every description for bridges and buildings. Of special note are the manufactures for court house, cell and jail work.

The Camp Engineering Co., located at 18 S. Canal st., Chicago, deals in engines, boilers, pumps, steam specialties, and second hand machinery. The company also makes designs and estimates for complete plants.

Richard B. Carr, offices 933-934 Monadnock Bldg., Chicago, represents as western agent the New Philadelphia Iron & Steel Co., whose specialties are black and galvanized sheets, and Reeves Bros., of Alliance, O., manufacturers of boilers and tanks.

Brown Bros. Mfg. Co.—The manufacture of side walk lights in various forms for illuminating basements has developed into a business of magnitude. The oldest house in this line in the West, Brown Bros. Mfg. Co., located at Jackson boulevard and Clinton st., was established in Chicago in 1860 and incorporated in 1874. In addition to the side walk light industry, the company operates a general foundry business, manufacturing among other things jack screws for house movers, and all sorts of castings for furnaces. It also manufactures the Gadey hollow blast grates for steam boilers.

American Trading & Storage Co.—The office of this firm is at 508 Western Union Bldg., Chicago. They are extensive dealers in relaying rails, car wheels and old railway material.

Walch & Wyeth.—This firm, 208-10 Lake st., is the distributing agent of the Magnesia steam pipe and boiler coverings manufactured by the Keasbey & Mattison Co., of Ambler, Pa. Their territory is the states of Illinois, Iowa and Northwestern Indiana. This covering is composed of not less than 85 per cent of magnesium carbonate. Neither heat nor water affects it, so that it is not harmed by leaks. It has been specified largely by the U. S. Government in the construction of war ships.

Chas. Kaestner & Co.—One of the firms which makes a specialty of power transmitting and coal handling machinery is the above named, located at 241-249 South Jefferson st. They also manufacture hydraulic-bucket and dipper dredges, grading and ballasting machinery, engines, boilers, pumps, etc. They are general machinists, founders, engineers and contractors and have a large and growing business.

Rosencrans & Mott.—This firm, located at 1236 Marquette Bldg., is composed of E. J. Rosencrans and A. D. Mott. They are consulting civil engineers.

Leschen-Macomber-Whyte Co.—This concern is the Chicago branch of the A. Leschen & Sons Rope Co., of St. Louis, and handles all kinds and qualities of wire rope, cordage, mining, railroad and quarry supplies. Its specialties are the "Hercules" wire rope (which has a red strand) and the "patent flattened strand." The firm is also agent for the Stephen Humble safety detaching hook, and among other specialties are steel tackle blocks, iron, steel and copper wire, bare and insulated. The office and warehouse are at 19-21 So. Canal st., Chicago.

The Oil City Boiler Works.—The works and general offices of this firm are at Oil City, Pa., and the Chicago office is in charge of W. J. Williams, who also represents the Oil City Tube Co., wrought pipe and casting. The boiler works manufacture a general line of boilers, engines and tanks and are the sole agents and manufacturers of the Geary water tube boiler.

Kellogg-Mackay-Cameron Co.—This firm manufactures and carries a very large line of steam and hot water boilers for heating purposes. Besides this they have on the market radiators, and job pipe, fittings, tubular and fire box boilers and a full line of steam fitters' supplies. The company, of which C. V. Kellogg is president; James Mackay, vice-president, and W. A. Cameron, treasurer, has its office at 110 Lake st., Chicago. It manufactures all the American Boiler Co.'s steam and hot water heaters.

I. W. Bollinger Co.—Mr. Bollinger, who is now located in the Monadnock Block, Chicago, has been connected with the iron and steel trade as manufacturers' agent for the past 15 years. He has represented of late the Wm. Clark Sons Co., of Pittsburg, Pa., the Terre Haute Iron & Steel Co., of Terre Haute, Ind., the Wabash Iron Co., of the same place, and the McCool Tube Co., of Beaver Falls, Pa. Mr. Bollinger has a large acquaintance with manufacturers and is alert and progressive. He is favorably known throughout the West and Middle West in iron and steel and hardware lines.

The Sall Mountain Asbestos Co., with mine and mill at Sautee, Ga., eastern office in the Bennett Bldg., New York, and main office 505 Chamber of Commerce, Chicago, puts on the market asbestos fibre, asbestos pipe and boiler covering, as well as deadening and fire proofing compounds.

The Abendroth and Root Mfg. Co.—The works cover some blocks of ground in Brooklyn, N. Y., and the Western office is at 1539-40 Monadnock Bldg., Chicago, in charge of William S. Love. Of late years heavy steel pipe lines for conveying water have come into general use. The Abendroth & Root Mfg. Co., manufacture a steel riveted pipe which is of stand-

ard quality. For conveying water the pipe is asphalted. It is also made galvanized and plain black. The galvanized pipe of lighter gauges is considered especially desirable for exhaust steam lines. Soil pipe is extensively manufactured.

S. Wilks Mfg. Co.—This concern is among the old establishments in Chicago, the business being first started here in 1856, by S. Wilks, for the construction of steel ranges, etc. Later the Wilks hot water heaters were developed and were pioneers. They have since been improved and are extensively used for all purposes of heating and supplying hot water in all quantities. In the last six years the business has been largely increased under the management of E. H. Sedgwick, and the new factory at 53-55 S. Clinton st., has all up-to-date facilities.

The Manufacturers Plating Works are located at 202-204 So. Clinton st., Chicago. High art nickel plating is done, as well as copper plating, in all shades and finishes. A specialty is made of architectural work in iron and brass.

Samuel Harris & Co., manufacturers of machinists' and mill supplies, have recently removed to their new building 23-25 South Clinton st. They are well equipped to fill orders promptly from a large stock of tools, and supplies of all kinds. They are Western agents for the Fulton wood split pulley, and also carry exclusively the Morse twist drill, S. W. Card's taps and dies, and Black Diamond files.

The Union Nut & Bolt Co.—The factories of this concern are located in Unionville, Conn., and Cleveland. The Chicago office is at 232 Lake st., under the management of C. C. Wood. The Union Nut & Bolt Co., manufacture hot and cold punched nuts, washers, bolts, rivets, axle clips, etc. Its trade is very extensive and among all classes of consumers.

The Green Engineering Co. installs complete steam plants of every description. The offices are 518-519 Western Union Bldg., Chicago. W. M. Green is president.

The Arcade File Works, of which Samuel W. Allerton is president, Courtlandt C. Clarke, secretary and treasurer, and Alfred Weed, vice-president and general manager, has its headquarters at 118 Lake st., Chicago. It was established in 1842. The products are superior warranted files and rasps. The company's extensive works are at Anderson, Ind.

Otis Elevator Co.—This important concern, with main offices in New York and Chicago, and branches in the other largest cities of the country, manufactures hydraulic, electric and steam elevators, for passenger and freight service. The officers are: N. P. Otis, chairman; W. D. Baldwin, president; A. G. Mills, vice-president; L. Belknop, treasurer. J. A. Roche is managing director of the Western department, the Chicago office of which is at 277 Dearborn st.

Chas. A. Ridgely & Co.—This firm is the agent of many manufacturers, in addition to carrying on a business in its own name. Its specialty is steel rails, including light mine rails besides iron and steel for the manufacture of agricultural implements. For the past seven years the concern has been located in Chicago, and has established facilities for prompt shipment. The office is at 1525 Old Colony Building.

The Kenwood Bridge Co. has works at Grand Crossing, Ill. The city office is at 617 First National Bank Bldg. Paul Willis is secretary and engineer of the company.

The Trenton Iron Co. has a Chicago office at 1114 Monadnock Bldg., in charge of H. N. Elmer. The company, of which Abram S. Hewitt is president, is a very well-known manufacturer of iron and steel, wire and wire rope, rods, patent wire rope tramways and quarry hoists, etc., the works being located at Trenton, N. J.

American Sidewalk Light Co.—This company consists of E. A. Schreiber and J. B. French. It manufactures concrete and Hyatt sidewalk, floor and skylight work, and, in general, all kinds of structural and ornamental iron work. The factory is very complete in its appliances. E. A. Schreiber has been in the business since the death of his father, A. E. Schreiber, who founded it in 1863. He is thoroughly familiar with all its details. The company is located at 156-158 West Ohio st.

The Acorn Brass Works.—This concern was started only four years ago and has grown rapidly. It is now at 19 to 23 S. Jefferson st., Chicago. The business is entirely of manufacturing brass and iron specialties and is fully equipped for all work in that line. The reputation of the products is excellent. J. S. Knight is president and general manager; J. W. Parks, vice-president; E. J. Clarke, secretary and treasurer; and T. J. Amelia, superintendent.

The Chicago Iron & Steel Co.—This company is well-equipped to handle all grades of iron and has a large patronage all over the Western country. Col. W. G. Bentley, the manager, is well-known, and his integrity has gained for the company a reputation for fair dealing that is a tangible asset. Louis Burnstein, the purchasing agent, has had a large and varied experience in handling iron from the raw material to the finished product. The offices are at 234 La Salle st.

The Carl Anderson Co.—The small horse power gas engine is now being used for many purposes where little power is needed, such as for pumping and electric light plants. The Carl Anderson Co. manufactures a gas engine which appears to be very economical, consuming only about one gallon of gasoline for each h. p. during 10 hours run. The gas engine in question is simple in construction and the governor is so constructed as to give the regular impulse so much desired for running electric light. Offices and works are at 64-70 N. Jefferson st., Chicago.

Chicago Water Motor & Fan Co.—This company, located at 171-173 Lake st., Chicago, sells the Backus gas and gasoline engines. These engines are extremely simple in construction and can be operated by men who are not skilled mechanics. It is claimed that they are far more economical than electric motors. A Milwaukee brass foundry, having a 10 h. p. electric motor, installed a Backus engine, and at 80c per thousand for gas the cost was half that of electricity.

August Pollak.—This business was started by Mr. Pollak, individually, in 1873, and was organized under a firm in 1886. It does a large scrap iron business in the West, and Middle West and trade is entirely wholesale. Mr. Pollak headed the syndicate which purchased the 22 largest World's Fair buildings. The yards are at South Chicago and offices 801-802 Western Union Bldg., Chicago.

The Dauchy Iron Works.—This company is located 84-92 Illinois st., Chicago, and deals in architectural and ornamental iron work. Sidewalk and vault lights are a specialty.

Chapman Valve Mfg. Co.—A large manufacturer of gate valves for steam, water, oil, gas, or ammonia is the Chapman Valve Mfg. Co., of 14 North Canal st., Chicago. This company's operations are entirely in the manufacture of valves and hydrants, and their products have been in large demand for the most exacting service.

James O'Donnell is manufacturers' agent for the Diamond State Iron Co., of Wilmington, Del.; P. F. Burke, Boston; the National Bolt & Rivet Works, the Burgess Steel & Iron Works, Portsmouth, O.; the Superior Steel Co., of Carnegie, Pa., and the Cambria Steel Co., of Johnstown, Pa. Mr. O'Donnell has a wide acquaintance and is favorably known to the trade. His office is room 504, 36 La Salle st.

W. Morava, located at 1243 Marquette Bldg., Chicago, is an engineer and contractor for all kinds of iron and steel construction. His operations have been on an increasingly extensive scale.

The Wm. D. Gibson Co. manufactures high grade crucible spiral and flat springs for all kinds of machinery. Upholsterers' springs are a specialty as well as springs for agricultural machinery and bicycles. The office and factory are located at 12-14 So. Jefferson st.

John Ramsay, located at the corner of Kingsbury and Ohio sts., Chicago, is a well-known foundryman. His plant supplies light and heavy castings of all descriptions. Castings for ammonia work are a specialty. Crushers, knives and brickyard supplies are other lines. Semi-steel is made on specification.

D. M. Quay & Co. are contractors and engineers for all kinds of steam heating and plumbing plants. Power plants and ventilating are also features of the business. Boston headquarters are in the Terminal Station and the Chicago office in the Monadnock Bldg

McClave, Brooks & Co.—One of the best devices for burning cheap coal under boilers and increasing their capacity from 40 to 75 per cent, is the McClave grate and Argand steam blower. With an ordinary tubular boiler it is guaran-

teed to develop far more h. p. per hour, using screenings, than can be obtained with natural draft from run of mine. This blower is manufactured by McClave, Brooks & Co., whose works and main office are at Scranton, Pa. W. A. Sharp is manager of their Chicago office, at 1104 Monadnock Bldg.

C. K. Pittman.—One of the most prominent and reliable firms that make a specialty of fuel for manufacturers' use, is C. K. Pittman, 990 Old Colony Bldg., Chicago. Since 1884 Mr. Pittman has made a special study of this branch of the fuel business. He is well fitted to supply the foundry coke and smithing coals that are needed in appropriate lines. He ships largely Connellsville and Davis coke, the Old Company Blossburg and the Big Vein Piedmont smithing coal and the best Lehigh anthracite.

The Amazon Chemical Mfg. Co., located at 41 Michigan st., manufactures the well-known Amazon vegetable boiler compound for the removal of incrustations from boilers. Other products are Amazon sheep dip, phosphorus of lime, and sulphate of ammonia.

The Massillon Bridge Co.—This well-known company, whose plant is at Massillon, O., designs and manufactures bridges and all other kinds of structural iron work. The Chicago offices are 755-756 Monadnock Bldg., in charge of J. C. Darstand and H. E. Hughes.

The Andrews Bros. Co.—The plant of this company is located at Youngstown, O., and it has offices at Chicago, 810-811 New York Life Building, and at Buffalo, with resident agents at St. Louis and San Francisco. The Youngstown plant consists of a blast furnace and rolling mills of modern equipment. The daily capacity of the mills is 175 tons of finished product such as bars, bands, hoops, and light sheets. The product is very widely known. The Chicago office was opened by John McLauchlan 15 years ago, and is still under his management.

Warner & Mann Co., 42 Michigan st., manufactures coffee and spice machinery, and Kearns' patent stationary and marine pop safety valves. The firm also repairs engines, pumps, and machinery, and builds special machinery to order.

Walburn-Swenson Co.—This concern, with offices at 944 Monadnock Bldg., Chicago, does engineering, iron foundry and machinery work. The business also includes the manufacture of cane and beet sugar machinery, and round bale cotton presses which are placed in the South by the American Cotton Co. The Walburn-Swenson Co., report business to be very satisfactory.

The Hallett Iron Works, 96 W. Polk st., manufactures all kinds of telegraph and telephone construction material.

The Board-Cumming Foundry Co.—W. S. Cumming is president, and J. L. Board, treasurer. The foundry and offices are located at 2848 Archer ave., Chicago. Products are gray iron castings made from high grade Scotch and Lake Superior irons. An extensive jobbing trade has been built up.

Greenlee Bros. & Co., manufacturers of special wood working machinery, with works at Twelfth, Union and Bunker sts., Chicago, are leaders in this line in the West. Their business was established before the Chicago fire by the two Greenlee brothers and their trade now extends to the entire world. They manufacture machinery for use in railway shops; also many special tools suited for general wood working and use in agricultural, furniture, wagon and pattern shops, contractors' work and mining timber construction.

Edward M. Hagar & Co. are the Western agents of the C. & G. Cooper Co., of Mt. Vernon, O., builders of heavy duty Corliss engines, and of the Mesta Machine Co., of Pittsburg, Pa., who produce all kind of rolling mill machinery, ingot molds, chilled and sand rolls, and pickling machines. The Southwark Foundry & Machine Co., of Philadelphia, is also represented. The offices are in The Rookery.

The Union Drop Forge Co. manufactures all descriptions of light forgings. It has a large capital and has an established trade all over the West and Northwest. Forges are at 64-76 East Ohio st., and offices at 901 The Temple.

Penn Oil & Supply Co.—This concern is the successor of the Penn Refining Co. Its main office and refinery is at Oil City, Pa., and it has offices at Chicago, 32 Milwaukee ave.; Burlington, Ia.; Rock Island, Ill.; Philadelphia, Pa.; New York; London, Eng; Hamburg and Mannheim, Germany, and Amsterdam and Rotterdam, Holland. They are refiners and wholesale dealers in Pennsylvania petroleum and its products. Specialties: High grade cylinder, valve, engine oils, illuminating oils, stove and gas machine gasolines.

S. Morris & Co.—This concern, which handles iron and steel scrap on a large scale, has a central location in Chicago and has 800 feet of railroad siding. The business was started in 1879 and has had a very rapid growth from the handling of a few hundred tons a month to about 60,000 tons a year. The company runs a full line of scrap iron shears and puts its scrap into any shape desired by mills and consumers. Offices are at 460-476 So. Canal st., Chicago.

The Crescent Drop Forge Co.—This company has works at Hegewisch, Ill. (136th st., Chicago), and offices at 1480 Old Colony Bldg., Chicago. The products are drop forgings, which are shipped over a wide territory.

The International Boiler Compound Co. manufactures solid, liquid and powdered boiler compound to prevent corrosion and remove scale. The company is also agent for the Dayton automatic compound feeder. A. M. Kinkard is president. The company is located at 47 Market st., Chicago.

The Stillwell-Bierce & Smith-Valle Co.—This company was organized in 1892 in Dayton, O., and is composed of the two firms named. They have two large plants in one of which they manufacture turbine water wheels, power transmitting machinery, refrigerating and ice making machinery, and feed water heaters. At the other they manufacture pumping machinery, cotton and linseed oil mills, filter presses and air compressors. They have developed many large water powers, and numbers of the Southern linseed oil mills have been equipped by them. They have also supplied many towns and cities with pumping plants. The company has built up an extensive foreign trade. Offices are established in the principal cities of the United States and in London. John T. Shay, 311 Dearborn st., is Chicago representative.

The Dearborn Drug & Chemical Works manufactures drugs, chemicals and solid extracts. The company also inspects and compounds Pennsylvania stocks and high class lubricants. Analytical work is also done, water analyses being a specialty. The works are located at 2327-29 La Salle st., and the offices at 29-33 Rialto.

Grafton & Knight Mfg. Co.—This firm, located at 171 South Canal st., Chicago, is engaged in the manufacture of belting, belt dressing and preservatives. Their factories and tannery are located at Worcester, Mass., where their first tannery was built in 1866. The officers of the company are, Joseph A. Knight, president; Henry C. Graton, treasurer, and Walter M Spaulding, secretary. In addition to their plant at Worcester they have offices at Atlanta, New York, Philadelphia and Portland, Ore.

Standard Pneumatic Tool Co.—This company manufactures pneumatic tools, such as drills, stamps, etc. The offices are at 1535-36 Marquette Bldg. Edward N. Huxley, is president.

The Marine Iron Works, Chicago.—The officers are: Adlai T. Ewing, president; James T. Hall, treasurer; W. G. Nourse, general manager. The most successful small craft (25 to 150 feet) are fitted with modern steam machinery built for that particular hull by some one company. For the entire district tributary to Chicago, including the Mississippi Valley, the Marine Iron Works are the one company who build all of the needed outfit, and make it their exclusive specialty.

Chicago Belting Co.—This concern is located at 67 to 71 South Canal st., and manufactures the "Reliance" leather belting. Chas. Allis is president, E. H. Ball, secretary, and J. M. Thomas, treasurer.

The Shelby Steel Tube Co., of Shelby, O., have a branch office at 135 Lake st. The company was the first manufacturer of cold drawn steel tubing in the United States, and has one of the largest plants in the country, producing tubes of all possible shapes, including round, square, corrugated, octagon, half circle, with double re-entering angles, etc.

The Standard Pneumatic Tool Co.—This firm has offices at 1535-1536 Marquette Bldg., Chicago, and 619 Washington Life Bldg., New York City. It is the manufacturer of the well-known "Little Giant" pneumatic piston drills, reversible

air boring machines, pneumatic hammers, riveters, flue rolling machines, and a large number of other pneumatic tools and appliances. These machines are in general use and are giving good results.

J. A. Sundberg has one of the best equipped shops in the West for the production of iron and steel forgings, smooth forged and rough turned. He manufactures die forgings for stamping work, forged steel flanges for boilers, tanks, etc., and does general blacksmithing. Mr. Sundberg reports an excellent trade and his factory, at 265 West Kinzie st., is running to full capacity. Offices are at 66 W. Washington st.

Tappan Steam Pump Works, of which Mr. A. K. Tappan is manager, began business in Chiago in 1875. Since that time Mr. Toppan has been continuously engaged in the manufacture of all kinds of steam pumps, his specialty being brewery and distilling work. He also manufactures air compressors for pumping artesian wells. Mr. Tappan's products have an extensive home sale, and his foreign trade is large and growing. The works are at 103-105 South Canal st., Chicago.

The Chicago Pneumatic Tool Co., with offices at 634-637 Monadnock Bldg., manufactures all kinds of pneumatic tools such as hammers, drills, riveters, welders, rollers, cutters, and reducers. The business has shown a steady growth, this being equally notable abroad, tools having been shipped to Johannesburg, South Africa, and Pago Pago, Samoa. The tools are used extensively in the U. S. Navy yards and in all railroad shops.

The Davis Coal & Coke Co.—The general office of this concern is located at Philadelphia, Pa., while C. W. Jackson is manager of the Chicago office in the Old Colony Bldg. The company puts on the market a low sulphur coke which is especially fitted for foundrymen's needs and as such is used extensively. Branch offices have been opened in New York, Baltimore, Boston, Trenton, Wilmington, and Washington.

W. S. Nott Co.—This concern is selling agent for Carey's magnesia flexible cement roofing and refined asphalt pitch. The Chicago offices are at 1562 Monadnock Bldg., and those at Minneapolis at 200-206 First ave.

The Andrews & Johnson Co., of which J. W. Andrews is president; E. H. Johnson, treasurer; and J. Roy Andrews, secretary, are heating and ventilating contractors and manufacturers of hot blast heating apparatus, blowers, exhaust fans, engines and sheet metal work. The company is located at 250-254 South Clinton st., Chicago.

Erie City Iron Works.—F. A. Gale is Western manager, with headquarters at 3436 W. Monroe st. At its Erie, Pa., plant the company manufactures Corliss, automatic and plain slide valve engines and water tube, stationary, vertical and portable boilers. It has an extensive western and Central Western trade.

F. R. McMullin Mfg. Co.—This company is a manufacturer of gas and gasoline engines and also designs and builds special machinery. In addition a machine shop for the making of tools and dies is operated. The business is located at 70-82 W. Jackson boulevard.

D. Q. Stephens & Co.—This company manufactures steam pipe and boiler coverings, and mineral wool for insulating and deadening. Other specialties are asbestos cement, hair felt, etc. The offices are at 136-140 Lake st.

Illinois Iron & Metal Co.—This concern, which was incorporated in 1890 with H. Lewinsky, president and treasurer, and M. Singer, vice-president and secretary, is a large dealer in scrap iron, metals and machinery. Special attention is paid to Chicago trade. The offices and yards are at 181-185 W. Taylor st.

Jacob Williams, with offices at 399-403 S. Canal st., and machine shop, 414-416 S. Canal st., is a wholesale dealer in scrap iron, metals and new and second hand machinery. All sizes of iron for forging purposes are kept, as well as pulleys, belting, shafting, rails, etc.

J. B. Doan & Co. are located at 68-70 South Canal st., and are the Western representatives of the American Tool Works Co., Cincinnati, O., formerly the Davis & Egan Machine Tool Co. In addition to this line, J. B. Doan & Co. do a large business in new and second hand tools of various descriptions.

A. J. Hewlings Co.—This concern represents a number of concerns making pop safety valves and gauges, regulators and steam traps, inspirators and ejectors and steam jet appliances. A large business is also done in asbestos, mineral wool and hair felt for a variety of uses. The office is at 218 Lake st.

H. S. Walker is a specialist in steam plant equipment for all purposes, and is agent for a large variety of apparatus in this connection. His office is at 1502 Monadnock Bldg.

The Hawley Down Draft Furnace Co.—This company, which is capitalized at $500,000, manufactures a well-known smokeless furnace, as well as "Excelsior Heaters" and Hutchison separators. The company has offices in all the principal cities of this country and also offices at Paris and Tokio.

John A. Roebling Sons Co., Trenton, N. J., have a branch store at 171-3 Lake st., under the management of Geo. C. Bailey. A full line of the company's products is carried, including iron and steel wire of every description, bare and insulated copper wire, wire cloth and nettings.

A. M. Castle & Co., 9 South Canal st., handle railway and boiler makers' supplies. They are the Western sales agents of the Lukens Iron & Steel Co., Coatesville, Pa., the Allison Manufacturing Co., Philadelphia, the Champion Rivet Co., Cleveland, O., and others. Besides this business, they manufacture the Drake-Castle patent pressed steel boiler lugs, hangers, flanges, etc., and copper ferrules.

The Norwich Belt Mfg. Co.—This concern is located at Norwich, Conn., and was founded in 1845. The Chicago establishment is at 33 North Canal st. The company manufactures pure oak leather belting and lace and pump valve leather.

The John Davis Co. is located at 51 to 79 Michigan st., and manufactures and handles wrought iron pipe, as well as plumbing, steam and water works material, and the "Eclipse" pressure regulators, back pressure valves, blow-off valves and pipe hangers.

La Fayette Bridge Co., of Lafayette, Ind., does a general bridge building business, and designs and erects other structural iron work. The Chicago office is at 1522 Monadnock Bldg.

The H. F. Watson Co., with mills at Erie, Pa., has offices at 192 Fifth ave., Chicago. This concern manufactures building and roofing papers, pipe and boiler covering, steam packings, asbestos roofing, carpet linings, and deals in various coal tar products.

Bement, Mills & Co., the machine tool manufacturers of Philadelphia, transact their Western business through Paul S. Pettele, Western representative, with headquarters at 1534 Marquette Bldg.

The Gates Iron Works have a very complete plant in Chicago consisting of foundry, machine shop, etc., manufacturing mining machinery of every description. The concern makes specialties of the Gates rock and ore breakers, steam stamp mills and cyanide and chlorination mills. They erect complete plants, under the direction of competent engineers.

The Babcock & Wilcox Co.—The Chicago interests of the Babcock & Wilcox water tube boilers are in charge of S. P. Wells, Jr., whose office is at 1215 Marquette Bldg.

The Buda Foundry & Mfg. Co's general office and works are at Starney, Ill. The Chicago office is at 917 Monadnock Bldg. The company manufactures steel wheel hand and push cars, railway castings and forgings, and general switch and track supplies.

Edward M. Hagar & Co., 556 "The Rookery," are Western representatives for a number of leading manufacturers of engines and machinery.

The American Tube & Iron Co.'s business in the Chicago district is in charge of O. T. Wilson, with headquarters at 1306 Fisher Bldg. The company's mills are at Middletown, Pa., and Youngstown, O.

The Block-Poilak Iron Co. makes a specialty of dealing in old railroad material, and handle a large tonnage at their yard at 52d and Wallace sts. The general offices are at 922-4 Marquette Bldg. Emil Poolak is president, and Jas. Block, general manager.

Hubbert & Hubbert deal in steel and iron. Their office is 1435 Monadnock Bldg. The firm represents a number of

prominent producers of various forms of finished iron and steel.

The American Screw Co., Providence, R. I., handles its Western business at 19 Lake st., the office being in charge of Henry A. Taylor, western manager.

The Tarrant Foundry Co.—At this foundry a specialty is made of dry sand and loam work, both light and heavy castings being produced. The foundry is located at Nos. 46 to 66 Indiana st.

The Paige Iron Works, located at Kingsbury and Ontario sts., does iron and steel forging and machine work. The plant contains special machinery for forging, planing, shearing, etc.

The Cleveland & Barr Foundry produces light gated and machinery castings, all of which are poured from soft gray iron. The plant is at 32 to 40 East Erie st.

John Featherstone's Sons, manufacture Corliss engines and ice and refrigerating machinery. The concern has a large trade in marine work of all kinds, and makes special machinery, as well as railroad and general castings. The plant is located at Nos. 354 to 358 N. Halsted st., and 2 to 36 Front st.

The Pyott Foundry Co., located at 76-82 N. Sangamon st., does a general foundry business, manufacturing light gray iron and machinery castings.

The Superior Boiler Works are situated at 131-133 West Superior st. Engines, boilers, steam pumps and special machinery are manufactured, besides tanks, smokestacks, shafting, pulleys, etc.

The Pacific Boiler Works are owned by Wm. Baragwanath & Son, who manufacture feed water heaters, purifiers, power boiler feed pumps, etc. The firm's works are located at 48-52 W. Division st.

F. Mayer & Co. are wholesale dealers in metals, and make a specialty of raw iron and steel and rails. Their offices are located at 356 Dearborn st.

The Wilson Iron Works, located at 171-173 Randolph st., produce special machinery and mechanical designs for the farm and ranch. The business is under the general management of A. H. Wilson.

The Northwestern Iron & Metal Co.—This concern is located at 308-309 Ft. Dearborn Bldg., Chicago. The officers are Lem Kattinsky, president; A. Levine, vice-president, and A. S. Farber, secretary and treasurer. The company operates the Wetherald Roll Mill located at Frankton, Ind , and does a general iron and steel business.

James B. Myers, 30 West Randolph st., an old pipe man, has been in business for over 20 years, and is now representing Spang, Chalfant & Co., of Pittsburg, Pa., manufacturers of full weight wrought iron, steam, gas and water pipe. They are among the oldest manufacturers in the United States, making their first pipe in 1834.

Wm Ganschow, located at 3537 South Canal st., makes a specialty of milling work of every description. Gear cutting is another branch, and machinery is made to order.

Cramp-Hoadley Co. sells in Chicago and Western territory the well-known Greene-Wheelock engine The offices are at 1490 Old Colony Bldg.

Ward & Nash, located in Boston, Mass., and Chicago at 35-37 So. Canal st., deal in iron, steel and metals. Some of the specialties are "Dannemora" tool and self-hardening steel, music wire, tubes, and springs for all purposes.

Howe, Brown & Co.—The Chicago office of this well-known Pittsburg company is located at 201-203 Lake st. It manufactures tool steel, and other crucible products. Among the specialties are Howe's special tool steel, plow and agricultural steel, crucible spring steel and plate steel.

The Fort Madison Iron Works Co., with works at Fort Madison, Iowa, have an office at 924 Monadnock Bldg., Chicago. Car wheels and railway castings are the special products. The officers are Wm. J. Watson, president; W. F. Bates, secretary and treasurer, and C. M. Hewitt, manager.

A. H. Dunham & Co.—This concern deals entirely in pig iron and its offices are rooms 608-609 No. 115 Dearborn st.

McDowell, Stocker & Co.—This business is located at 59-61 South Canal st. The firm deals in new and second hand machinery. Emery wheels, and other abrasives are a specialty. Screw machines, drills, planers, lathes, etc., are also kept in stock.

The Northwestern Boiler Works manufacture steam boilers, tanks, smokestacks, etc. Repairing is also done. Chris. Pfeiffer is proprietor. Offices, 66 Michigan st.

Chas. L. Bastian Mfg. Co., 76-8 Illinois st. The company manufactures specialties for liquid carbonic acid and fire department supplies. The plant includes a brass foundry and equipment for oxidizing, plating and polishing.

M. W. Phalen, 10 South Canal st., carries full stock of the steel products of the Benj. Atha & Illingworth Co., and the steel shafting of Bliss & Laughlin, which concerns he represents in the district.

Kling Bros.—This firm manufactures the Chicago gas and gasoline engines, their works being at 287 Hawthorne ave. In addition a general manufacturing business is done, the lines including steam engines, printing presses, plate and sheet iron work, etc.

The Pearson Machine Co.—This concern builds machine tools and automatic machinery. The works are at 31-45 West Randolph st.

The W. D. Kent Co.—The plant is located at 216-222 Union st., the company being successor to M. Benner & Co. It manufactures and deals in all descriptions of structural and ornamental iron work. Combination fire escapes and standpipes are a specialty.

Daly & Anderson.—This firm is located at 51 S. Clinton st., and is composed of Geo. Daly and C. W. Anderson. Both are practical millwrights and machinists and repair and erect all kinds of machinery. They furnish also hangers, pulleys and rope transmission equipment, and a full line of grate bars is carried. Syrup mixers and sugar grainers are other specialties.

The Union Nut & Bolt Co., with factories at Unionville, Conn., and Cleveland, O., has a Chicago office at 232 Lake st., under charge of C. C. Wood. The products are hot and cold punched nuts, washers, bolts, rivets, axle clips, and boxwood rules.

The National Boiler Works.—This plant is located at 56-60 Fulton st. The output consists of boilers, breechings, tanks, stand-pipes, fronts, stacks, grates, etc. The concern also has a complete set of improved machinery for flanging boiler heads and irregular shapes. The officers are Jennie Bee, president; D. R. Cormode, secretary and treasurer, and Geo. Warrington, manager.

The Goodsell Packing Co.—The products of this company are all styles of high grade engine packings, including rubber back flax packing, piston rod packing, special hydraulic packing, stitched pump packing, etc. B. W. Goodsell is proprietor. Offices and works are at 33 S. Canal st.

The Steel Tired Wheel Co.—This company was formed three years ago by the merging of the various concerns manufacturing pressed car wheels with steel tires. The Western representative is J. L. Woods, 980 Old Colony Bldg.

The Dorrance Co.—This concern, of which Charles J. Dorrance is president, has offices in the Western Union Bldg., and manufactures fuel economizing devices, among other things the Dorrance smokeless furnaces and the Dorrance grate bars.

Lemley & Schultz, who manufacture machinery and special tools, are located at 31-33 Indiana st. They deal in engines, boilers, steam pumps, tannery and stone machinery, mining cars, dry kiln trucks and do general blacksmithing.

R. M. Cherrie & Co., located in the Western Union Bldg., Chicago, deal in railway material of all kinds, also scrap iron and steel, pig iron and coke.

M. McGregor & Co., dealers in new and second hand machinery, are located at 39 W. Washington st., Chicago, Ill. The firm also deals in portable and stationary engines, boilers, wood and iron working machinery, and power transmission devices.

Union Foundry Works.—This concern does architectural and general foundry work and constructs fire escapes. The office is 417 First National Bank Bldg. W. R. Gwinn is president and treasurer, and James Damey, secretary. The works are on Greenwood ave.

Chicago Steam Engine Works, Franklin and Michigan sts. This concern manufactures marine and stationary engines, and makes a specialty of elevator repairs and the manufacture of artesian well tools and stone yard machinery.

The Fuel Economizer Co., Matteawan, N. Y., is represented in the West by Geo. H. Klumph, with an office at 1105 Monadnock Bldg.

Gould Coupler Co.—This concern is a large manufacturer of railroad supplies and equipment, including the M. C. B. freight, passenger, tender and pilot couplers, continuous platforms and buffers, vestibules, axles and malleable castings. The works are at Buffalo and Depew, N. Y., and Anderson, Ind. The Chicago office is at 941 The Rookery.

Chicago as a Great Iron and Steel Center.

INTRODUCTORY.

BY E. C. POTTER.

In no particular was the epoch-making year 1898 more remarkable than in the extraordinary position in which the American iron and steel industry established itself during the twelve-month. From the beginning until two years ago the market for all kinds of American iron and steel products was confined strictly within the boundaries of our own country. Previous to 1896 the most fevered imagination did not contemplate a foreign trade for this industry. To-day our market is the world and our iron-masters are the dictators thereof. This is not merely development, it is revolution. In two years the course of trade has been reversed; long established traditions have been overthrown; the usages of centuries have been uprooted; and the seemingly impossible has become reality. When we remember that the history of the American iron and steel industry is practically compassed within a single generation, the situation invites reminiscence; and it is well to fix firmly in our minds the mile-posts which mark the progress of the most wonderful industrial achievement the world has known.

A Glance Backward.

The American iron and steel industry, in its present commercial significance, dates its birth from the introduction of the Bessemer process in 1864. Of course, it is understood that iron was made in this country before the Revolutionary war, and the manufacture of both pig iron and wrought iron had attained to a considerable magnitude and importance before the Civil War. Indeed, many of our largest and most prosperous establishments of to day were then leaders in the manufacture of both raw and finished iron. Yet, be it remembered that the industry was most infantile when compared with the overtowering supremacy of England. England led the world in the manufacture of iron and had ever held this commanding position. All we knew of the business was derived from England. All of our methods and most of our skilled workmen were British. Moreover, we were very large importers from England, our puny efforts being no match for her and no bar to her competition. In short, we confessed ourselves pupils and imitators of our English cousins in the production of iron. Then came the Bessemer process, an English invention, and with it came Alex. L. Holley. This was the beginning of the American iron and steel industry. The Bessemer process began a new era in the metallurgical world and an epoch in the American iron trade. Holley took the Bessemer process and plant as he found it in England and, applying to it his fertile Yankee ingenuity, gave to its development in this country a character peculiarly American.

The first Bessemer steel made in this country was made in a small experimental plant erected at Wyandotte, Mich., by the late Capt. E. B. Ward, for the purpose of testing and proving the Kelly patents, which were practically identical with those of Bessemer. This was in 1864 and steel made in this plant was rolled into rails at the works of the North Chicago Rolling Mill Co. in May, 1865. In the same year, Mr Holley, operating under the English patents of Bessemer, produced steel at the Troy works, and carried the operations of this plant practically to a commercial success. The consolidation of the Kelly and Bessemer interests in 1866 put the new process on a business basis and in 1867 the works of the Pennsylvania Steel Co. made their first blow, being the first works built for the operation of the Bessemer process on a commercial scale. These works were designed and built by Holley as were eight or ten works that followed this one in rapid succession. Each new works embodied some new and radical departure from the accepted English models and each succeeding plant contained new and radical improvements in the direction of simplicity and economy of operation and increase of output; so that, in a very few years, there were recognized to be two methods of Bessemer practice—the English, or Bessemer's, and the American, or Holley's.

The American Striving for Great Tonnages.

Thenceforth, the divergence grew rapidly wider between the two. The Americans, having to deal with very expensive labor, devoted their energies and ingenuity to the development of machinery to replace men and to increase the output per man employed; while the English, favored (apparently) with cheap labor, were content with securing economies in the consumption of fuel and raw material without much radical improvement in mechanical appliances and consequent saving of labor and increase of output. A friendly, but none the less keen rivalry was set up between the various American works in the matter of output and soon the remarkable yields of American Bessemer works and rail mills were heralded far and wide and received with absolute incredulity by our English cousins. As illustrative of this development a few instances that come within the writer's experience may be given. In 1876 a certain works was producing 1,200 tons of ingots and 800 tons of rails per week. In 1886, the same works, without material change of any kind, was producing 3,300 tons of ingots and 3,000 tons of rails per week. In 1882 a new works—the then largest in the country—produced 3,000 tons ingots and 2,400 tons rails per week. In 1898 the same works, with a remodeled rail mill and the addition of a blowing engine and some minor improvements about the pit in the Bessemer works, made the same tonnage in a *single day!*

The same striving for large outputs was also applied to the blast furnace and with the same results, so that by 1880 American blast furnace practice was beginning to excite discussion among the iron-masters of Europe. Our practice was still wanting in a very essential particular, namely, the economical consumption of fuel. Our large outputs of pig iron were secured by the extravagant use of fuel, and a time was near at hand when acute competition necessitated a more careful consideration of this feature. It might reasonably be expected that in those localities where fuel was most expensive the most determined efforts towards its economical use might be found. So it was that in 1885, at the South Chicago furnaces, a long series of experiments resulted in the production of a ton of pig iron with the consumption of less than a ton of fuel, and this, too, without reduction but rather increase of output.

When we remember that up to this time the average consumption of fuel was about a ton and a half per ton of pig iron produced, we realized how significant was this improvement. This practice soon became general throughout the country, while the yields of furnaces continued to increase. The development in this regard was even more wonderful than in the case of the Bessemer works. A furnace that in 1880 was yielding 800 tons per week on a fuel consumption of rather more than 3,000 pounds of coke per ton of iron, in 1890, without any change except the substitution of fire-brick stoves for iron pipe stoves, yielded regularly 1,400 tons per week on a fuel consumption of 1,850 pounds of coke per ton of iron. The performance of this furnace was not at all exceptional but was typical of the revolution that had been wrought in ten years in this branch of the iron industry. The same development was going on as well in all other departments of manufacture of both raw and finished material, and America was fitting herself, quite without realizing it, for the great destiny that awaited her.

Chicago as a Rival to Pittsburg.

The settlement of the fuel problem in the blast furnaces at South Chicago had a still wider and deeper significance in that it firmly established Chicago as a formidable rival to Pittsburg as a steel manufacturing center. Up to this time, although Chicago had some little advantage in its proximity to the Lake Superior ore fields, the advantage lay with Pittsburg, inasmuch as Chicago drew its entire supply of coke from the immediate neighborhood of the former city. When the consumption of coke was so large per ton of iron this was a serious handicap, but with the great reduction in coke accomplished the two cities were more nearly on an even footing. Although Pittsburg might, and did, equal Chicago's furnace

practice, they could not save as much in dollars and cents because they did not have it to save.

From this time forth the cost of making a ton of pig iron did not differ very much as between Pittsburg and Chicago, and it was not long before Chicago took another step in the direction of both intrenchment and retrenchment. This was the consolidation of the three great works situated in and near Chicago, forming the Illinois Steel Co., thus bringing under a common interest and management three rival concerns, with its resultant saving of general and other expenses and the diversification of the product. This move practically made Chicago the mistress of the American iron and steel industry, leading up, as it did, to the organization of a still broader and more powerful consolidation of steel works, iron ore and coal properties and railways under the title of the Federal Steel Co. This company has under its control every item of raw material that goes into the manufacture of iron and steel, with the transportation thereof, as well as the iron and steel works themselves, and is undoubtedly the greatest industrial organization on earth.

The Campaign for Foreign Markets.

These consolidations of interests, of which the Federal Steel Co. is but one, the American Steel & Wire Co. and the American Tin Plate Co. being other noteworthy examples, were brought about primarily by the severity of competition. This competition still continued, after the original merger of Chicago plants referred to above, the consolidated interests being the better prepared to meet it, and at length prices of finished material reached an undreamed-of limit. This competition was brought about in its turn, by an excess of capacity for production and a series of years of commercial depression and light demand for the products of the works. Thus in the struggle for business prices were so forced down that the American iron-masters suddenly awoke to the fact that they could undersell European makers in the markets of the world; and this, too, without strain.

The policy and labors of those captains of industry, many of whom have passed to their great reward, who have made our iron and steel industry what it is to-day, have at last borne fruit. Our works, which are largely automatic, are almost independent of the uncertainties of manual labor. The labor we do employ still receives good wages—double and treble the wages of European workmen—and is content. Enormous output, many times that of similar works in Europe, has reduced to a minimum the incidental expenses and fixed charges. The European iron master, who leaned upon cheap labor as his chief prop, has nothing left now but a reduction in wages when he wishes to cheapen his cost. When his workmen are reduced to starvation point he can go no further. He may imitate American plants and machinery but he cannot better them. The control of the markets of the world is lost to him forever, and the position of the American iron master is impregnable. We have entered into our heritage. We have witnessed the inspiring spectacle of the steel works at Chicago, 1,000 miles from the Atlantic seaboard and 2,300 from the Pacific, shipping rails and wire to Japan; ship plates to Glasgow and Belfast; and material of all kinds to localities in Europe, Asia and Africa. We have seen English railways purchasing American rails. We have seen English ships built of American plates. We have seen American locomotives hauling English trains. We have seen English electric railways driven by American machinery. We have seen Alabama pig iron supplying European foundries. We have seen Asiatic railroads built and equipped throughout with the products of American workshops and American labor.

In brief, the United States, with her inexhaustible natural resources; with her incomparable system of railways furnishing the cheapest and most reliable transportation conceivable; with her wonderful industrial development every department of which displays the highest attainments in rapid and economical output and excellence of workmanship; and with her intelligent, skilful and well-paid workmen, has moved steadily forward to the destiny that the inexorable sequence of events has prepared for her; and in the year of grace 1898 she assumed her rightful place as commercial mistress of the world.

Chicago, Ill.

CHICAGO'S IRON AND STEEL INTERESTS.

The iron industry of the Chicago district has not yet rounded out to the full proportions which the conditions warrants. The fact that ship plates have been shipped from Chicago to the United Kingdom, while structural material and a variety of steel products are shipped to Chicago from districts much nearer the seacost, is a simple proof of the unevenness of the development so far. The position of Chicago with relation to the fields from which the raw materials of the iron industry are drawn enables it to produce at low prime cost, and being able, as has been proved, to ship its products in certain lines far beyond its prescribed territory, there is no question that it should be able to supply the entire demands of tributary districts, in nearly all iron and steel lines. It is due to the wonderful richness of the territory centering in Chicago, and the facilities for reaching that territory from Chicago, that the prospects of the district's marked development are so bright. The system of railroads centering in Chicago is an unrivaled one, and they are not only heavy consumers of various forms of iron and steel, but they make possible the transportation of Chicago's iron and steel products to a wide stretch of territory, at advantageous freight rates.

The foundation of the iron and steel industry is pig iron. The raw materials of pig iron are ore, coke and limestone. Limestone Chicago has as convenient to its furnaces as any district. It was many years ago that the theoretical yield of pig iron per ton of ore was closely approached. It is only within recent years that the yield of iron per unit of coke consumed has been up to the standard of present practice; and the theoretical limit of economy in the use of coke has not been so nearly approached as in the case of iron ore. Chicago is near the iron ore, and far from the coke—at least the coke which so far it has been considered necessary to use. As improvements in blast furnace practice will be in the direction of reducing coke consumption, rather than ore consumption, per ton of iron produced, as has been shown, Chicago is certain to profit by what progress may yet be made in this direction, and cannot in any case lose any relative advantage as compared with other districts. Besides its nearness to the Lake Superior ore fields, as compared with other regions using these ores, Chicago possesses further advantage, which occasionally is of considerable importance, in that it can bring ores from this region by rail during the winter months when other districts are shut off, owing to the interruption of lake navigation. In recent years large stockpiles at Lake Erie ports have made the situation of tributary furnacemen an easy one, but these stocks are now small and are likely to continue so.

A Foundry Iron Center.

A very important part of Chicago's production of crude iron goes to the foundries of the district and the surrounding territory. The foundry interests in the great region tributary to Chicago are very important, and are growing at a rapid rate as the country becomes richer and turns to iron to supplant other materials for a thousand and one uses. The great wave of improvement in methods and devices which has only in recent years begun to sweep over the foundry trade of the country will help Chicago in one important particular. The old rule of thumb system, if it may be called a system, of mixing iron for foundry use by fracture and by the district in which it is produced, is rapidly being supplanted by a more scientific and satisfactory system, that of mixing by analysis. This is tending rapidly to increase the use of the pig iron produced from the various Lake Superior ores, instead of mixing these irons with a large proportion of iron from other districts, because it is being found that the required grades for foundry use, when determined by chemical analysis, can be produced in Chicago furnaces wholly from Lake Superior ores.

This reference to some things that may be expected in the development of the Chicago iron industry in the future is all that is necessary. The size of the industry at present is shown by the following table of approximate quantities of raw materials received and pig iron produced by the furnaces of the Chicago district in 1897 and 1898:

	1897.	1898.
Ore (gross tons)	1,982,667	2,564,294
Furnace coke (net tons)	1,217,160	1,559,904
Pig iron and spiegel (gross tons)	1,184,812	1,461,583

The increase in receipts of ore in 1898 over 1897 was over 29 per cent; the increase in production of pig iron and spiegel was over 23 per cent. The production of rails, standard and light sections, was 436,477 gross tons in 1897, and 576,566 tons in 1898, a gain of over 32 per cent. It is needless to say that in the present condition of the iron industry, not taking account of any special influences which may affect this district, the figures in these lines for 1899 must considerably surpass those for 1898.

The blast furnaces in the Chicago district number 17. Of these 15 belong to the Illinois Steel Co., and are customarily active. The Iroquois Furnace, which recently passed into the control of Rogers, Brown & Co. interests, is ordinarily active, while the Calumet Furnace, not active since 1896, has recently been taken over by a concern formed by Chicago and Cleveland parties, the South Chicago Furnace Co., and is being put in shape so that it will be blown in shortly.

Steel Works and Rolling Mills.

The principal steel manufacturing interest in the Chicago district is the Illinois Steel Co., which has three steel works located in the district. Besides this concern there are the Latrobe Steel Co., having a works at Melrose Park making open-hearth steel castings, and the Sargent Co., having a plant in Chicago making crucible steel and oen-hearth steel castings. The annual capacity of these various works in the Chicago district is 217,500 gross tons of open-hearth steel, 1,425,000 tons of Bessemer steel, and 900 tons of crucible steel, or a total of 1,643,400 tons The total production of open-hearth and Bessemmer steel in the United States in 1898 was 8,829,509 tons, so that this geographically small district production comparatively large percentage of the total, its works being operated last year quite up to their capacity.

The rolling mill interests of the distinctively Chicago district are more extensive than the steel producing interests, and are in a greater number of hands. Besides the various works of the Illinois Steel Co., with works in the Chicago district at Joliet, South Chicago, and in the city of Chicago proper, we have at Joliet the Great Western tin plate works of the American Tin Plate Co., and the McKenna Steel Working Co.'s plant; at South Chicago the Calumet Iron & Steel Co.'s plant, which has been idle for some time, but is now to be rehabilitated; at Hammond, Ind., the plants of the Lakeside Nail Co. and the Corning Steel Co.; at East Chicago Ind., the works of the Inland Iron & Forge Co. and the Chicago Horse Shoe Co.; at Chicago Heights the works of the Inland Steel Co.; at Waukegan, the Waukegan works of the Washburn & Moen Manufacturing Co., and in the city of Chicago the plant of the Sellers Manufacturing Co.

To give an idea of the rolling capacity of these various plants, the following summary of active stands of rolls may be given: One 3-high 40-inch, one 3-high 35-inch and one 36-inch blooming mill, with one mill 40x84 inches, for blooms, billets or slabs; one 3-high 25-inch and one 23-inch rail train; four complete continuous rod mills; four stands of 3-high 27-inch finishing rolls; two plate mills, 34x90 inches and 34x132 inches; one 22-inch nail plate train and a 24-inch slab mill; seven 22-inch sheet mills; four 24-inch tin mills, two 24-inch, one 15-inch, one 14 inch, one 12-inch, two 9-inch, and one 8-inch merchant mills.

Outside of crude steel and rails, the capacity of these various rolling mills, per year, is about as follows: 70,000 tons of plates, 300,000 tons of wire rods, 45,000 tons of railroad supplies, such as splice bars, spikes, bolts, nuts, washers, etc., 12,000 tons of sheet steel, 7,000 tons of tin plate, 1,500 tons of harrow teeth, 600,000 kegs of cut nails, 30,000 tons of bar steel, 100,000 steel plow beams, and 100,000 tons of "renewed" rails.

Of special interest in the Chicago district is the plant at Joliet, which operates under a patented process, taking worn-out railroad rails and rolling them into serviceable rails. The process consists mainly in forcing of the metal which has been worn down from the top of the head, and the weight per yard of the rail is reduced only a very few pounds by the operation. A considerable part of the business is the rolling of "seconds" from regular rail mills, by which these seconds are made into good serviceable rails.

The wire interests in and around Chicago are very extensive, steel wire, both bright and galvanized, and copper wire, being manufactured. At the Waukegan Works, of the Washburn & Moen Mfg. Co., now a part of the American Steel & Wire Co., there is a rod mill for producing both steel and copper rods, and drawing capacity for 60,000 tons of wire a year. The Grand Crossing Tack Co., Chicago, is erecting a rod mill for steel wire rods. There are six wire drawing plants in the district, and the total wire drawing capacity amounts to about 280,000 tons a year. There are eight wire nail plants in the district, having a total capacity of considerably over 2,000,000 kegs of wire nails a year.

One of the distinctive Chicago industries is the manufacture of tin cans. The plant of Norton Bros., at Maywood, Ill., turns out millions of cans every week. The work is all done by automatic machinery, and a can is turned out complete in an incredibly short space of time. The machinery also tests and counts the cans. No one who has not closely followed the subject has any idea of the immense variety of use to which tin cans are now being put, and the scope of the industry is constantly enlarging. Groceries, proprietory articles, druggists' supplies, tobacco and many other things formerly put up in paper or wooden boxes are now being largely packed in tin cans. The adoption of the tin can has been due to the great cheapening in tin plate since the introduction of the industry into this country, and the perfection of can making machinery. There are only a very few plants in the country which can compare with the one at Maywood, and they are nearly all owned by Norton Bros., who have plants in New York, Maryland and Ontario, Canada. In connection with the plant at Maywood is a very complete tin house for tinning the black plates preparatory to manufacturing the cans, and this plant contains some features not used in any other tin house in the country.

Boiler, Bridge and Car Works.

The boiler making industry is very well represented in Chicago, a number of the largest concerns in the country being located in the region, including one of the large water tube boiler manufacturers. Of interest also is the shipbuilding business of the Chicago Ship Building Co. (now a part of the American Ship Building Co.), which builds a large number of lake vessels every year.

The six bridge building concerns of Illinois are all located within a very short distance from Chicago, a number being within the city limits. The industry is largely dependent upon the great number of railways centering in Chicago, for which a very large tonnage of bridges is constructed every year. The six concerns also erect iron and steel buildings, and their total annual capacity is 88,500 tons. The bridge building business is only a small part of that furnished by the railroads to the manufacturing plants, which make a large variety of material for railroads. Some of these have already been mentioned, but notice must be taken also of the car works, and the numerous plants which make parts of cars, such as axles, wheels, trucks, etc. There are five plants in and near Chicago making cars, including passenger coaches, freight cars and various small cars for mines, plantations, street railways, etc. The most important are the well-known works of the Pullman's Palace Car Co., at Pullman, where passenger, street and freight cars are manufactured. Besides the iron car axle works connected with the Pullman industry, there are two other concerns making car axles, having between them an annual capacity of 125,000 axles. The manufacture of car wheels also constitutes an important industry, there being six car wheel foundries in the region. Some of these are connected with the car making plants. One makes steel tired paper wheels, with metal centers. The capacity of the all-metal wheel plants is over 600,000 wheels a year. The Pressed Steel Car Co., of Pittsburg, has a plant at Joliet, formerly under control of the Fox Pressed Steel Equipment Co., at which car trucks and other parts are manufactured for wooden and steel freight cars, under a number of patents.

Foundries and Machine Shops.

The foundry interests of the Chicago district are of the greatest importance. Not only is there a very wide territory

which depends largely on Chicago foundries for its castings and machinery, but there are a number of large works in and about Chicago which have a trade all over the country and in some cases ship a large part of their product to foreign countries. There are some whose product have a reputation all over the world. The steel casting interests have already been referred to. A considerable trade is done in malleable iron, the Illinois Malleable Iron Co. having a plumbing, steam, gas and water works supply plant, and one of the four great plants of the National Malleable Castings Co. being located in Chicago. But the heavy end of the foundry business is grey iron casting. There are nearly 100 foundries in Chicago alone. It is estimated that the foundries in the northern half of Illinois and in the Northwest melt between 400,000 and 500,000 tons of iron a year. Much of this iron is made in the blast furnaces of the district, while nearly as much comes from Tennessee and Alabama. The Ohio Scotch and silvery irons are used, in comparatively small quantities, to complete the mix.

The largest foundries in Chicago are those of the Barnum & Richardson Mfg. Co., Board-Cumming Foundry Co., Chicago Stove Works, the Crane Co., Deering Harvester Co., R. M. Eddy Foundry Co., Famous Mfg. Co., Fraser & Chalmers, Griffin Wheel Co., McCormick Harvesting Machine Co., McGreevy & Haggerty, National Malleable Castings Co., A. Plamondon Mfg. Co., Plano Mfg. Co., Vierling, McDowell & Co., Walburn-Swenson Co., Webster Mfg. Co , Weir & Craig Mfg. Co., Wells & French Co., W. A. Jones, Western Electric Co., Link-Belt Machinery Co., and Western FoundryCo.

The manufacture of mining machinery is a leading branch of this industry. Mining machinery from Chicago is known all over the world. It has been installed all over North and South America, in China, Japan, Australia, Norway, Portugal, Spain, Hungary, Russia, Italy and many other countries. The mining machinery interests devote attention to all branches of precious metal, iron and coal mining. Among the leading manufacturers are Fraser & Chalmers, the M. C. Bullock Mfg. Co., the Excelsior Iron Works, and the Gates Iron Works. The manufacture of el vators is another important branch, two of the plants located in Chicago have a good reputation all over the country for their elevators for various purposes.

An industry which has naturally developed to very great proportions in Chicago is the manufacture of grain handling machinery, on account of the local demand. A number of large concerns are devoted to this line, and grain handling machinery is shipped to all grain snipping and elevating centers.

Probably the largest single branch of the foundry and machinery interests of Chicago is the manufacture of farm machinery, including agricultural implements, wagons, and other supplies for the farm and ranch. The rich farming territory of the West looks to Chicago very largely for its supplies in this direction. The Deering Harvester Co. and the McCormick Harvesting Machine Co. have each enjoyed an international reputation for many years. The concerns engaged in this line have developed the machinery for automatically doing the farmer's work, and the United States leads the world in farm machinery, through the energy and inventive ability of the Chicago firms engaged in this line.

A very important branch of the foundry business in Chicago and vicinity is the manufacture of stoves. Chicago is perhaps the largest center for the distribution of stoves in the world, and while a large part of the stoves handled comes from other manufacturing districts, yet the foundries of Chicago turn out a large tonnage of stoves. The lines mentioned constitute only a few branches of the foundry interests. The variety is very wide, and includes such important lines as steam engines for various uses, small locomotives, electrical castings for dynamos and motors, etc., etc.

Chicago has become in the last few years one of the leading centers of bicycle manufacture. There are more bicycle manufacturers within the corporate limits of Chicago than in any other equal area in the world. Many of the concerns are large makers, manufacturing the bicycle from the raw material almost, while there are others which buy the material in a more finished form, down to the small repair man, who buys parts complete and merely assembles them.

AIR SUPPLY IN STEEL MAKING.

TO THE EDITOR:

In your issue of April 13 was an article by Dr. Richard Moldenke on oxygen in steel, caused by an excess of air in open-hearth furnaces. It has suggested that a determination of the percentage of carbon dioxide in the combustion gases could be used as a guide in regulating the air supply. The writer has used the econometer with excellent results in regulating the air supply to oil burning furnaces under boilers, the point of minimum air supply being readily shown. With this instrument the gases from the furnace are passed through a glass bell at one end of a scale beam, and are weighed, a pointer attached to the beam of the scale pointing to a graduated index on which different percentages by volume of carbon dioxide are shown. The position of the index pointer depends on the greater or less amount of carbon dioxide in the gas, which, owing to its greater specific gravity, affects the weight of the volume of gas being weighed, in proportion to the amuont present. The gas is continually drawn through the instrument by a mild suction so that the indication may be continuous. While the writer has never experimented with this particular application, there seems to be no reason why the method should not be of considerable value.

By this means the proper regulation of the air supply to hot blast stoves could be secured, it being of course understood that the economic efficiency of a stove may be seriously reduced by improper air supply, because if furnished in greater amount than required the excess must pass away without being used, carrying heat with it, or if supplied in insufficient amount a portion of the gas escapes without being burned. The writer is not aware that such determinations as mentioned have ever been attempted in connection with regular working, but the subject is certainly one which might be examined with profit. A. BEMENT.

Chicago, April 28.

CHAMPION RIVET CO.'S NEW PLANT.

The Champion Rivet Co., of Cleveland, manufacturer of the Victor boiler rivets is now in its new plant, which is well located on the Erie Railway at the junction of Union st., in Newburgh. The company owns over 800 feet on the track, extending back over 300 feet, and its buildings occupy about one-third of the property. The manufacture of Champion boiler rivets was begun in a small way in the spring of 1894, and step by step the company has gained a footing with the trade until to-day its Victor boiler rivets are known in almost every boiler shop in the country, and are liberally specified by leading mechanical engineers.

The new plant is equipped with an entire new outfit of power and machinery, rivet making machines, consisting of solid die machines, cold and hot heading machines, cutting off machines, etc., made specially for the company's work under its own patents. The fuel used is fuel oil, which insures a uniform and mellow fire in the furnaces, and is handled automatically in a way that obviates entirely the liability of burning the metal.

The Champion Rivet Co. occupies a unique position, its factory being the only one in the country making a specialty of boiler rivets alone. It is the practice never to unload a pound of steel into the works without first having it analyzed by regularly engaged chemists, whose analysis card must be in hand before orders are given for unloading the steel. The company also has in vogue among its workmen a merit system by which the men are paid not alone for the tonnage they turn out, but for the mechanical perfection of their work. This is calculated to insure a rivet which is mechanically perfect, as well as chemically and physically up to the highest standard.

The company is owned and managed by Wilson B. Chisholm, vice-president and general manager of the Cleveland Rolling Mill Co. for the past 25 years; Edward S. Page, secretary of the Cleveland Rolling Mill Co. for the past 27 years, and David J. Champion, connected with the Cleveland Rolling Mill Co as salesman for the past 18 years. The long and varied experience of these gentlemen in the iron and steel business insures their company's success in its important field.

The company is now manufacturing rivets for the boilers for the new battleship Maine, also rivets for the Imperial Russian cruisers and Russian battleship, for all of which the Wm. Cramp & Sons Ship & Engine Building Co., of Philadelphia, is under contract, the boilers being built by the Stirling Co., of Barberton, O.

UEHLING'S METHOD OF CASTING AND CONVEYING METALS.

One of the most important advances in blast furnaces which has ever been made has been the introduction of the machine for casting the pigs in iron molds. There has been no change in blast furnace practice which has been of more practical advantage to the foundryman than this, although the foundryman has not yet become a unit in appreciating the advantages of sandless pig iron. The accompanying engravings, Figs. 1 and 2, show the Uehling method of casting and conveying pig iron, as applied to the two Carrie furnaces at Rankin, Pa. Last spring, not long before these furnaces were sold to the Carnegie Steel Co., Ltd., by the Carrie Furnace Co.

There have been many experiments made, for years past, looking to the displacement of the system of casting pig iron in sand, on account of the many advantages which would evidently accrue. One of the most important of these, namely, having the pig iron free from sand, is very apparent in many of the uses to which pig iron is put. In the case of the basic open-hearth process, the advantages of a sandless pig are of the utmost importance, because the sand is very destructive to the lining of the furnace, and has a tendency to retard the removal of sulphur. The experiments which led to the present apparatus and system were carried on at the Lucy furnaces of the Carnegie Steel Co., some years ago, the company being especially desirous of having a pig iron free from sand, for use in the new basic open-hearth furnaces at Homestead. Since the success at the Lucy Furnaces, the system and apparatus have been installed at a large number of the blast furnaces, and the many advantages of a sandless pig have become more apparent, as the number of consumers of the product increased, the foundrymen finding on trial that the sandless pig iron offered advantages to them equally with the basic open-hearth steel manufacturer.

The fundamental principle is that of casting the molten iron as it comes from the furnaces, in traveling molds made of cast iron, and lined with lime or other refractory substance. These traveling molds are arranged side by side in a continuous strand which passes over drums which are, in the case of the Carrie machine illustrated, 125 feet from center to center. There are two of these strands, side by side. They are clearly seen in Fig. 1. The metal is carried in ladles from the furnace tap hole and emptied into the pouring pot, shown in the engraving. This pot is tilted, through gearing, by one man, and the metal is poured into the molds. The forward movement of the molds is uniform, the quantity of metal flowing into each mold being regulated by the rapidity of pouring. The molds have a blunt V-shaped cavity, the length being 24 inches at the top, with a width of 10 inches and a depth of 5 inches. These molds are cast direct from the blast furnace, and have a life of about 150 tons each, when they are remelted, their value as pig iron being in no wise impaired by their use as molds. The coating of the insides of the molds by lime, or other refractory material, which is done to decrease the effect of the molten iron poured into them, is accomplished by spraying the mold with lime water on their return trip, when the cavity is downward. This coating of the inside of the mold with lime is absolutely essential to the proper working of the apparatus. Without it the molds would crack and break readily, while the molten iron would tend to stick to the mold and could only be dislodged with difficulty. The spraying with lime water has been found to be the most effective coating method, and constitutes one of the most vital points in a casting machine. This method is fully covered by the Uehling patents.

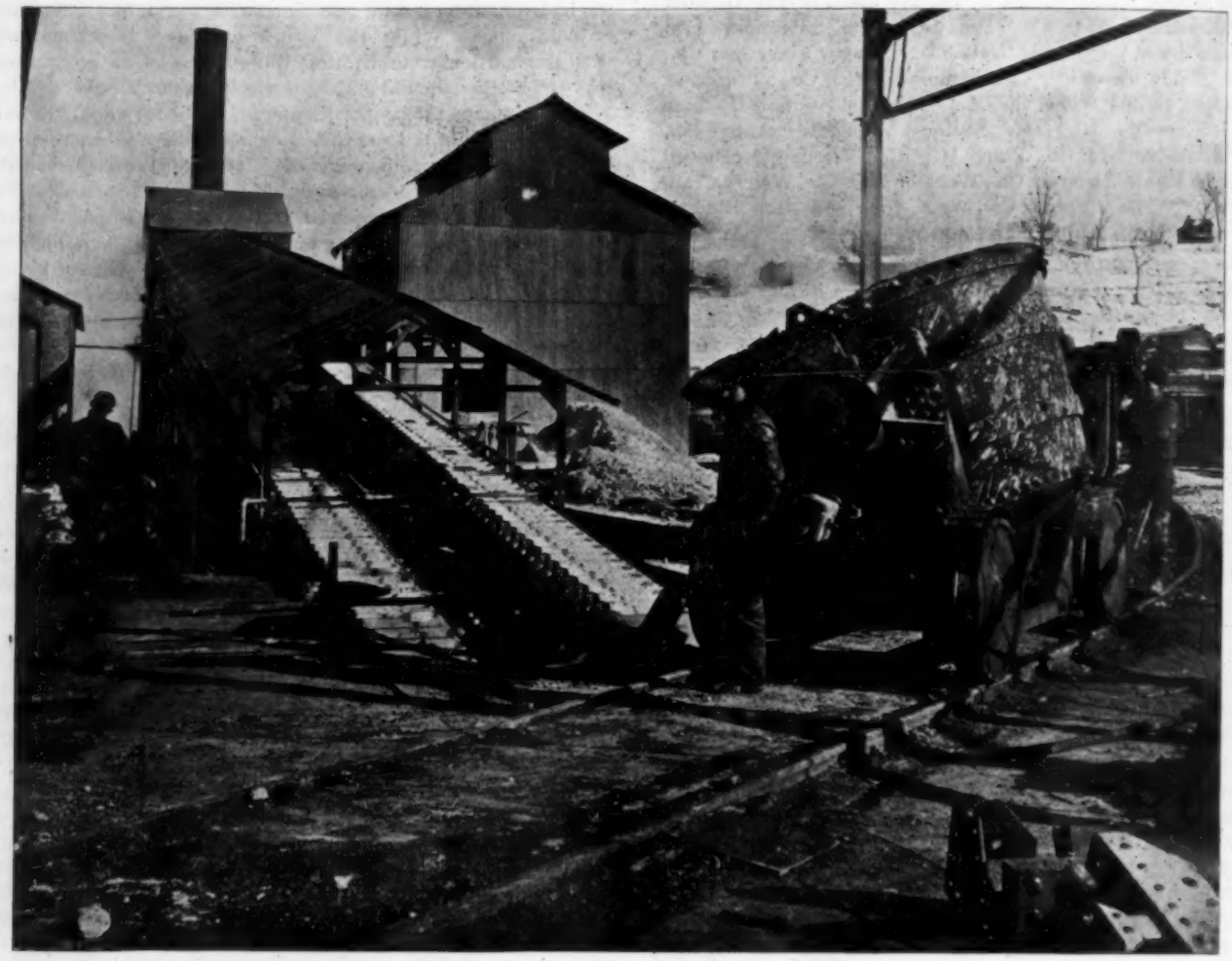


FIG. 1.—UEHLING CASTING AND CONVEYING APPARATUS AT CARRIE FURNACES, RANKIN, PA.

As the speed of the molds is about 15 feet per minute, it will be seen that in about eight minutes the pigs will have reached the end of travel of the mold strand, where they are dropped, by the rotation of the molds around the farther drum, onto the conveyor. This conveyor is shown in Fig. 2. The shed seen in Fig. 1 covering the far end of the mold strands, with a smoke stack behind it, appears to the left in Fig. 2, with a stack in front of it. In Fig. 2 is seen the conveyor, which lies in the direct prolongation of the line of the mold strands of Fig. 1. The eight minutes which elapse from the time the

pig is cast until it drops to this conveyor, is sufficient to soidify it. During the first part of the mold's travel on the conveyor it passes down and into the water tank, which completely cools it, then passing up again with the conveyor it reaches the end of the conveyor's travel, and drops into the chute, from which it falls into the railroad car standing on the siding, which is provided with a scale at this point. The conveyor is composed of ¾-inch steel plates, carried on chains.

The average quantity of pig iron cast at the two Carrie furnaces is 800 tons every 24 hours. A single strand machine would be sufficient for this tonnage, but the double strand is installed as a safeguard. A similar sized machine, at the Duquesne furnaces, has handled as much as 1,700 tons of iron in 24 hours.

The Uehling method is now in use at 39 stacks in the United States, having a daily capacity of 14,700 tons, and there are 47 furnaces which have expressed an intention of adopting the system, and are likely to ask for licenses at any time.

A SPECIAL dispatch from New York states that in connection with the Manhattan's long discussed change of motive power, some important extensions in the line northward will be made, the tracks being laid on the surface, instead of elevated. Frederick B. Esler, president of the Metropolis Contract Co., is quoted as saying: "In order to make the changes necessary for the operation of the new motive power, which in valves new steel rails and other materials, my company, upon the expert testimony of many engineers, entered into contracts with the Carnegie Steel Co. and the Lackawanna Steel & Iron Co., so that there would be no chance of loss owing to a rise in the price of materials. There has been an obstacle in the way of the promulgation of the scheme—namely, the debt limit of the city, but this being removed, there is no longer any reason why the contracts should be withheld. The company I represent is ready to provide a satisfactory underwriting syndicate should it be awarded the contract and promises to have the road in operation within two years and a half."

THE W. Dewees Wood Co., McKeesport, Pa , is reported to be planning for the addition of two sheet mills to its plant.

SOUND CASTINGS.

BY HENRY HANSEN.

Periodically questions are asked on this subject after private experiments have failed to remedy the fault. A foundryman will find a number of pin-holes in his castings and looking at his pig iron will discover cavities of a similar appearance. Then he jumps at the conclusion that the iron is bad and that in some occult manner the holes are transferred from it to the casting. Advocating the use of low-grade pig iron in place of scrap may be a good theory from the standpoint of the pig iron salesman but it is not so from that of the foundryman. Taking it for granted that it is possible to ignore the accumulation of scrap iron it would still be anything but a matter of economy to do so.

What most people desire is an iron that is both strong and soft, where machining is involved. An open-grained iron is relatively weak. Two ways are open for closing the grain and making the iron stronger. One is the addition of low grade pig iron. The other is to remelt the open-grained iron which brings the molecules in closer contact. Both plans will make stronger castings, but the latter will produce greater softness with an equal amount of strength. It is for this reason that scrap is valuable. Some people condemn stove plate scrap, because it is one of the traditions handed down that it is not good. Yet, upon remelting, it furnishes a casting that is both strong and soft. A soft scrap iron is one of the best additions that can be made to an iron mixture. While a pig iron having the same constituents would leave the casting open-grained, the scrap will give a greater strength with equal softness.

The opinion has been advanced that inferior and dirty scrap is responsible for the unsatisfactory mixtures occasionally found. What is called inferior iron is generally a hard iron; but I fail to see that this makes the iron inferior, for with suitable additions of iron higher in silicon it again becomes "good" iron There is really no such a thing as inferior iron or bad iron to the man who knows how to use it. I know

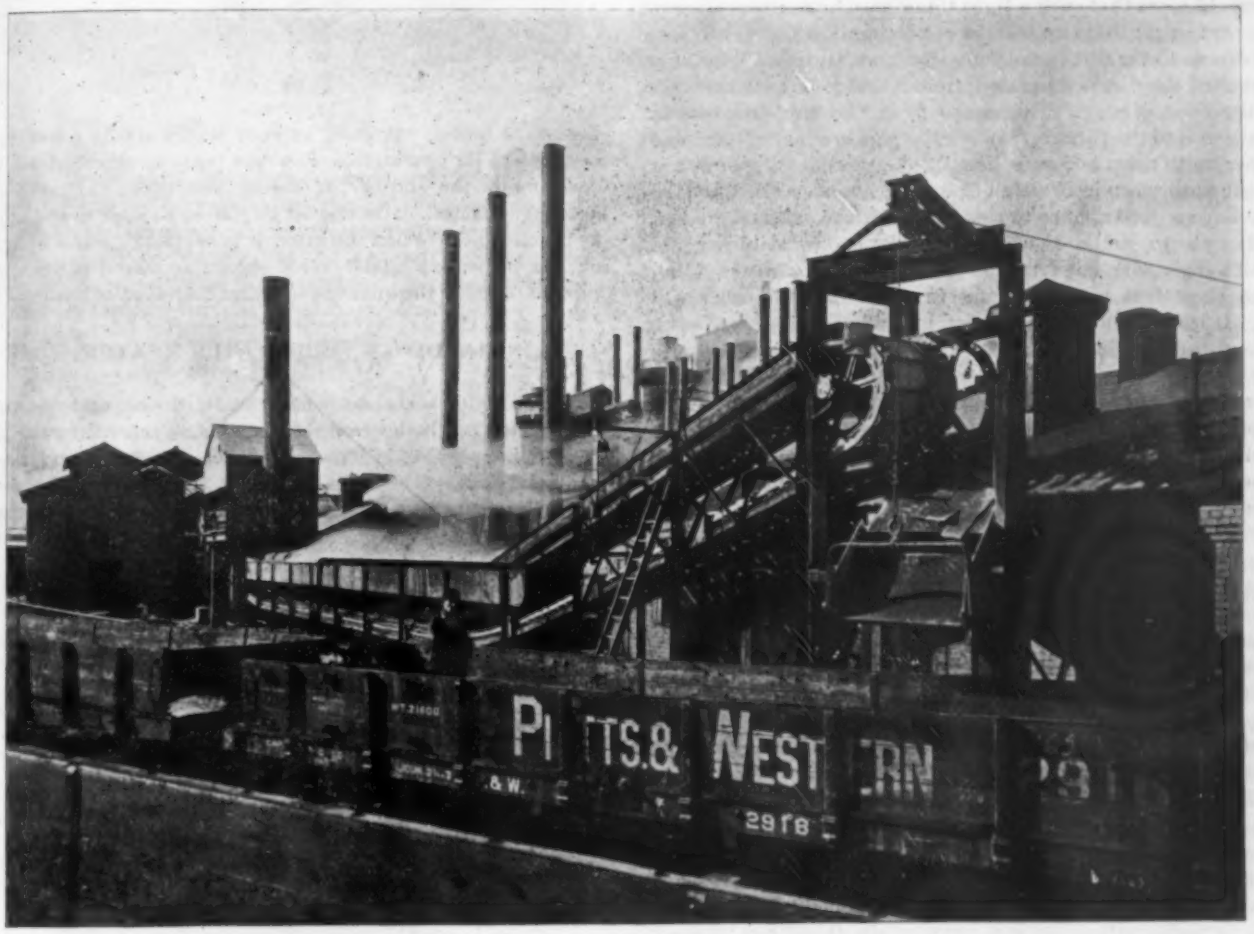


FIG. 2.—UEHLING CASTING AND CONVEYING APPARATUS AT CARRIE FURNACES, RANKIN, PA.

there are foundries with a large assortment of scrap, domestic and imported--and probably a shipment or two of pig iron, also—which they declare their inability to use; but such conditions are not the fault of the iron. The blame instead rests with the owners.

Then we have the man who says he can't get clean castings because his scrap iron is dirty. He is another innocent prevaricator, 18 karats pure. When you meet one of these people take him out into the yard and show him all the dirt that is on the pig iron; then break a ragged edged "sow" or two for him and show him all the shrinkholes, blowholes and dirt said "sow" contains. By this time he will likely begin to think that the pig iron is largely to blame for his dirty castings and between it and the scrap he will have a time to figure out how he is going to get clean castings.

I have heard several attempted explanations of the method by which the blowholes in the piece of pig iron is transferred to a casting; but I have never been able to follow the route it took in getting there. Of course the pig iron melts all around that hole, and what bothers me is to account for the hole descending to the bottom of the cupola. When we consider how such heavy things as cinders are blown out of the cupola, it would seem that such a light thing as a hole in a piece of pig iron ought to go up instead of coming down.

Now as to the dirt in both pig iron and scrap. When iron is melted the dirt is separated from it and rises to the surface in the form of slag. This is so from the time the ore is charged into the furnace. When the pigs are melted the sand adhering to them becomes slag. So does the dirt and rust attached to scrap iron. Melt the iron hot, so that the slag will have a good chance to rise to the surface and add enough soft iron to make the casting meet your requirements Most people who have trouble with dirty iron are juggling with their fuel record, trying to see how little coke will do. If iron is simply thawed out instead of being melted it does not obtain fluidity enough to give the dirt a chance to get out.

Iron that is properly melted will leave more slag in the cupola and less in the iron. If the dirt and slag in pig iron will leave the iron in being melted why should not the same take place in melting scrap? Why should not the sand on a sprue leave the iron as readily as the sand on a pig?

Where the iron is drawn from the cupola in small quantities I believe the habit of making large charges is generally responsible if castings are not of uniform quality. Every cupola having its melting zone, above and below which no melting occurs, it seems to me that it would be possible that in a heavy charge the pig iron would occupy the entire zone, thus preventing any scrap from melting until part of the pig iron has been removed by the same process. Such a contingency would make itself specially noticeable when the iron is poured as rapidly as melted.

Holes in ordinary gray iron castings are always caused by conditions existing outside of the pig iron and the cupola. It is not possible to transfer a hole. I have made castings that were more or less covered with minute pin holes, but this was not the fault of the iron. It happened when I undertook to make castings an inch or more in thickness in sand only suitable for light bench work. When I made them in sand open enough to suit the work the trouble entirely disappeared. The holes we see in pig iron are no inherent property of the iron, but the effects of conditions existing in the casting house of the blast furnace. Pig molds are not made with the exquisite care the molder bestows upon a casting and when we consider the rapidity with which they are made and the great surface of floor space closely covered at a tapping it is not to be wondered at that there is an occasional pig bubbling from the uneven temper of the sand or the gas which is generated by such a large amount of metal. But in no way does this permanently affect the iron any more than a core blow injures a casting for subsequent remelting.

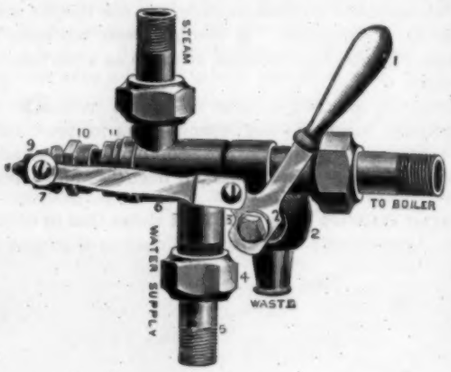
With iron melted at the proper temperature the cause of dirt and holes in the castings lie entirely outside of the cupola, pig iron and scrap. To sum up: all iron is good iron if a man knows how to use it.

Plymouth, Mich.

MARLIN & Co., Pittsburg, manufacturing sheet metal goods, are erecting a new plant at Twenty-Second and Smallman streets, Pittsburg, 120x160 feet and two stories.

EXCELSIOR BOILER FEEDER.

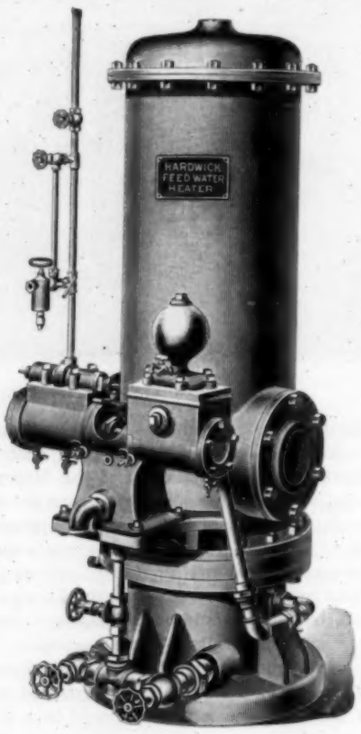
N. A. Watson, of Erie, Pa., manufactures the Excelsior boiler feeder of which an illustration is given herewith. It is designed for lifting water from well or creek, heating and forcing it into the boiler when the engine is standing as well as running, and no adjustment is necessary for varying steam pressure. It is operated by the use of a single lever. In connecting with the boiler dry, steam is taken from the highest part of the boiler and connection is made with the coupling on



top of the feeder. A globe valve is placed at the point most convenient for operation. The feed pipe is attached to the coupling on the end of the feeder and taken to the boiler opening. A check valve should be placed as near to the boiler as practicable. When the injector is supplied from a hydrant or tank pressure a globe valve should be placed in the water pipe to regulate the quantity of water delivered to the injector

HARDWICK FEED WATER HEATER.

A feed water heater known as the Hardwick, and combined with which is a boiler feed pump, is manufactured by the Erie Mfg. & Supply Co., of Erie, Pa. There is a cast iron outer shell and base. The tubes (of either seamless brass or iron) are free to expand or contract independently of the others.

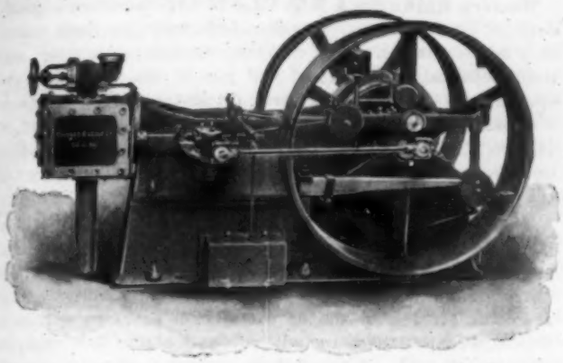


The base, or water chamber, has an air space in the center, preventing the cold water from cooling the chamber on the opposite side containing hot water on its way to the boiler. Every heater is tested to a hydraulic pressure of 200 pounds. The inlet steam having been distributed around the tubes containing the feed water passes up and over a division plate

and discharges on opposite side at the bottom. The hand-holes are placed in the bottom of the base for convenience in removing sediment. Blow-off pipes are also placed in the cold and hot water chamber.

THE SKINNER ENGINE.

The Skinner Engine Co., of Erie, Pa., has been engaged in the manufacture of engines since 1873 and has turned out upwards of 6,000. It has devoted itself to the production of an automatic engine that an be cared for successfully by an engineer capable of running an ordinary throttling engine,



avoiding complicated construction and yet giving high efficiency. The builders claim for their engine special governing features and an exceptionally efficient system of automatic lubrication. The company's line of high and medium speed engines has been perfected in the past few years and they are built in sizes ranging from 25 to 250 h. p.

CRANK-PIN OIL CUP.

The Cyclone crank-pin oil cup with wiper attachment and removable shank, is manufactured by the Keystone Brass Co., 1017-1019 Peach st., Erie, Pa., manufacturers of special brass goods, and castings for engine-builders, steam fitters, plumbers and kindred branches. Of these cups, patented Feb. 27, 1894 and Nov. 3, 1896, the one here illustrated has double

feed; one through a hole in the disc A, for fine regulation to the capacity of the cup; the other through the wiper, feeding an extra amount of oil needed at any time. It is particularly adapted for large high speed engines, making long runs. Being made flat-sided a very large cup can be used on center crank engines, being easily attached by means of the patent removable shank, for which special wrench is furnished.

The Burger Wire & Iron Works Co., East South st., Akron, O., manufactures iron fencing, fire escapes, railings, balconies, stable fittings, office railings, elevator enclosures, window guards, wire signs, etc. Special iron and wire work is done. They are in position to execute orders promptly.

Wisconsin Iron Interests.

Important Works in Milwaukee and Other Industrial Centers.

The iron industry in Wisconsin is something over 50 years old. In 1859 mention was made by Lesley, as noted in Mr. James M. Swank's "Iron in All Ages," of three charcoal furnaces in the state—Northwestern at Mayville, 40 miles north west of Milwaukee, and built in 1848; Ironton, built in 1857 by Jonas Tower; and Black River, built in 1857 on the east bank of Black River, near the falls, in Jackson county. Of these the Mayville furnace is the only one still in operation—having been rebuilt twice, and in 1887 remodeled and enlarged to use coke. In 1896 it was again enlarged. The Black River furnace gave way in 1885 to a modern charcoal furnace, the Minneapolis, but this in turn has been abandoned. In addition to the Northwestern, the blast furnaces in Wisconsin using coke as a fuel are the No. 1 and No. 2 stacks of the Illinois Steel Co., at Bay View, having an annual capacity of 130,000 gross tons; and Minerva Furnace, at Milwaukee, having an annual capacity of 40,000 tons. The latter has been idle since 1896, and to-day is being repaired, preparatory to going again into blast. The only active charcoal furnace in Wisconsin to-day is Hinkle at Ashland, operated by the Ashland Iron & Steel Co. Its capacity is 45,000 gross tons a year.

Wisconsin's rolling mill history began in 1868, when the Milwaukee Iron Co. built the plant now operated by the Illinois Steel Co., at Bay View. It was erected at first for the re-rolling of iron rails, but afterward manufactured new rails. In 1874 a merchant bar mill was added; to this was added a nail mill in 1884. To-day the annual product is 115,000 gross tons of light rails, cotton ties and steel bars and 30,000 tons of angle and splice bars. The West Superior Iron & Steel Works were built in 1890-91, and are equipped with two 4-gross ton Bessemer converters, 5 heating furnaces and plate and bar trains, but the plant is now idle with no early prospect of resumption. Three steel casting plants are located at Milwaukee—the Milwaukee Steel Casting Co., which has two crucible steel melting furnaces with 24 pots and one 6,000-lb. acid open-hearth steel furnace; the Shaw Steel Casting Co., whose plant consists of four crucible steel melting furnaces with 3 chambers each, and a 1-gross ton acid open-hearth steel furnace; and the J. A. & P. E. Dutcher Co., which has six 6-pot crucible steel melting furnaces, and one 3-gross ton Wellman rotary acid open-hearth furnace. The Eagle Horse Shoe Co., South Milwaukee, has operated a rolling mill for the past seven years, producing bar iron for horse and mule shoes. Of the latter 120,000 kegs are turned out in a year.

The wire and wire nail plants of Wisconsin are at Milwaukee, Janesville, and Cedarburg. The Janesville Barb Wire Co., has 8 nail machines and its annual capacity is 50,000 kegs. The Milwaukee Tack Co., has 22 machines and a capacity of 40,000 kegs a year. The Badger Nail Co., Milwaukee, draws wire from No. 0 to No. 20, annual capacity 9,000 tons, and has 25 nail machines which can turn out 150,000 kegs of steel, brass and copper nails a year. The Cedarburg Wire Nail & Screw Co., draws wire and manufactures wire nails.

Iron-Working Plants.

There are two bridge companies in Wisconsin that are important factors in structural operations in the Northwest—the Milwaukee Bridge & Iron Works, annual capacity 8,000 tons, and the Wisconsin Bridge & Iron Co., annual capacity 10,000 tons.

Seven malleable iron works have a combined yearly capacity of 40,000 tons a year of agricultural, railroad, wagon, carriage and saddlery castings. In the order of production they are the Wisconsin Malleable Iron Co., and the Northwestern Malleable Iron Co., at Milwaukee; the Belle City Malleable Iron Co., Racine; the Beaver Dam Malleable Iron Co., Beaver Dam; the Racine Malleable & Wrought Iron Co. and the Lake Side Malleable Iron Co., Racine, and the Waukesha Malleable Iron Co., Waukesha.

Among the stamping firms Milwaukee is represented by the Geuder & Paeschke Mfg. Co., and the Milwaukee Stamping Works.

Among the engineering works those of the Edward P. Allis Co., at Milwaukee, are pre-eminent. Engines for mining, blast furnace and steel works duty have gone from their shops to all the important iron and steel companies in the country. Their pumping engines and their saw mill machinery are also famous. Milwaukee is the important foundry center of the state, 20 concerns in that city melting iron in the cupola. The leading implement firms in the state are at Milwaukee, and Racine. In machinery manufacture, outside of Milwaukee, the leading concerns are at Madison, Green Bay, Beloit, Racine, Janesville, Oshkosh, La Crosse, Sheboygan and Waukesha. In the following paragraphs mention is made of many of the leading manufacturers and iron workers at these pionts.

MILWAUKEE.

The Milwaukee Steel Casting Co.—This concern is located at the corner of Clinton st. and Greenfield ave., and its products are crucible and acid open-hearth steel castings, the annual capacity being 1,100 gross tons. Wm. O. Vilter is president; Solomon Shaw, vice-president, and Theo. F. Wambold, secretary and treasurer.

The Wisconsin Machinery Co.—The plant is at 125-127 West Water st. The company deals in new and second hand machinery, engines, boilers, pumps, heaters, mill and engineers' supplies. Complete power plants are also installed.

Milwaukee Leather Belting Co.—The product is pure oak leather belting. Belts are also repaired, made endless and put on. Rubber belting, packing and hose are kept in stock. E. W. Sikes is manager of the company, which is located at 136 Sycamore st.

Milwaukee Harvester Co.—One of the most important implement concerns in the Northwest is this company, whose plant is at 155-59 Huron st. Milwaukee twine binders and mower are its products and they have attained a wide and favorable reputation throughout the country.

The Berghoefer Mfg. Co. are millwrights, machinists and engineers and build improved machinery for handling coal, ice, stone, grain, etc. Plans and estimates are furnished for complete plants. The works are at 136 Sycamore st.

The Eagle Horse Shoe Co.—This concern was founded at South Milwaukee, Wis., in 1892. The increase of business has compelled it to enlarge its plant, which now covers double the space at the beginning. The products consist of horse and mule shoes, iron and steel, a leading specialty being "right and left" hind shoes which save work for the shoer. The officers of the company are G. B. Van Norman, president; Jas. McAlpine, vice-president and treasurer, and L. A. McElroy, secretary and general manager.

The Milwaukee-Rice Machinery Co., located at 165-167 West Water st, Milwaukee, have had a rapid and healthy growth; from a modest beginning in the spring of '93 to a foremost position as dealers in power transmitting, elevating, conveying and general machinery, being also the largest Wisconsin dealers in leather, rubber and cotton belting. They give special attention to complete power generating and transmission plants, and have competent engineers in charge of this branch.

Pfeiffer & Smith.—This firm is located at 128-130 Ferry st., Milwaukee, Wis., and manufactures a large line of special machinery. Other manufactures are punch presses, emery grinders and buffing lathes, while a specialty is made of an automatic stop weaving machine for manufacturing woven wire mattresses.

Kearney & Trecker.—This is a new concern, established at Milwaukee in May, 1898. The firm manufactures standard and special machine tools. The plant is very complete and both partners have large experience. They put out multiple spindle drilling machines of special design and having from 2 to 16 spindles. The plant is located at 271 Lake st. and 145 Clinton st.

Frank Toepfer.—Mr. Frank Toepfer, located at 460 National ave., Milwaukee, is a native of Bohemia, who came to this country in 1866. After working for various firms he started out for himself and now manufactures fire escapes, well boring tools, iron fences, etc. An invention of Mr. Toepfer is a cigar box nailing machine. Six sons have all become machinists.

Sheriffs Mfg. Co.—This concern was established in Milwaukee in 1849. In 1890 it was incorporated with W. H. Meyer, president; F. C. Starke, vice-president, and T. W. Sheriffs, secretary and treasurer. Its products are propeller wheels, marine machinery of all kinds, dredge machinery, marine engines, triple, compound and high pressure styles, also brass and iron castings and general forgings. The Sheriffs propeller wheel goes to all parts of the United States and Canada as well as to the West India Islands.

Western Hardware & Mfg. Co.—L. Kreielsheimer is president, A. Kreielsheimer, vice-president, and Jos. Bach, secretary and treasurer. The company manufactures iron and brass bedsteads, gasoline, oil and gas st ves, and hardware specialties. A new factory was built last year, and there is a steadily increasing demand, not only at home, but in Mexico, Cuba and Puerto Rico, for their goods. The office and works are located between Dover and West sts., and the C. M. & St. P. Ry.

The Greenslade Foundry Co. was established at Milwaukee in 1880. The brick foundry building is 180x75 feet, and is equipped with traveling cranes and all other modern appliances. Architectural, machinery and gas apparatus castings are manufactured to the extent of over 500 tons a month. The firm's specialties include columns, stairs, fire escapes, shutters, etc. O. W. Greenslade is president and treasurer, and John Greenslade is secretary. The total of raw materials used in all branches in 1899 will be 9,000 tons.

The Spring Lake Iron Co.'s charcoal furnace is located at Fruitport, Mich. The company was organized in 1879 with a capital of $200,000 and its principal office is in Milwaukee. Its output is about 30,000 tons a year, when running steadily, the output being marketed mostly in Ohio and the Northwestern States. The president is Irving M. Bean; vice-president, Charles F. Ilsley; treasurer, Samuel Marshall; secretary, J. C. Ford.

Hoffman & Billings Mfg. Co., 96 100 Second st., Milwaukee, manufactures a complete line of brass and iron goods for steam, gas and water. Other products are iron and brass valves, iron cocks and square bead cast iron fittings. The firm is also jobber for A. M. Byer & Co.'s wrought iron pipe, Knowles & Blake steam pumps and Alexander Bros. leather belting. The officers are F. Hoffmann, president; E. P. Niedecken, vice-president, and J. B. Kalvelage, secretary and treasurer.

The Vilter Mfg. Co. started in 1867 and is well known as a builder of improved Corliss engines, also of refrigerating and ice making machines, and brewers' and bottlers' machinery. The Corliss engines are built with girder or heavy duty frame and simple, compound and compound condensing. The plant of the company is very extensive, with all modern improvements including a 15-ton crane, and railroad tracks enter the establishment. Its engines and refrigerating machines are in use in all parts of the country.

Andrew Kopperud, Madison and Barclay sts., Milwaukee, manufactures artesian and shallow well tools and steam forgings for cranks, connecting rods, valve stems, gear blanks, etc. He is a practical mechanic and pays personal attention to all work done.

Schwab & Sercomb.—This concern, located in Milwaukee in 1881, has had a steady growth. A few specialties are manufactured, but the greatest success has been the Gilt Edge warm air furnace which is considered among the best of its kind. Mr. Sercomb is well known to iron men in the West and Northwest, having been connected with the Western Foundrymen's Association as an officer since its foundation. He was president in 1897.

The Western Malleable & Grey Iron Mfg. Co.'s buildings at Chase and Burrell sts., are a foundry 200x70 feet and brick machine shops, three stories, 200x60 feet. W. J. Turner is president; J. M. Morgan, treasurer and manager. The company was established in 1872, and was formerly located at Port Washington, Wis. Light gray iron castings are made to order, office chair irons, furniture castings, etc. There are also fitting and japanning departments.

The Filer & Stowell Co.—The business was established in

1856 by John M. Stowell, a New Yorker. In 1870 the corporation was formed. Its chief product is saw mills, and in this line the facilities for manufacture are exceptionally complete. Other products are Corliss engines, steam pumps, compression and power pumps and transmission machinery. A large and increasing trade is carried on with Europe and South America.

The Milwaukee Steel Casting Co. changed hands in the fall of 1898. It is now on a better basis than at any time in its history. It has just put in a Tropenas converter and is in position to make any size of casting up to 20 tons. The company is doing a good business, which is increasing daily, and the prospects for the future are very encouraging.

The Edward P. Allis Co.—This business was founded in 1860 by Edward P. Allis, of New York, who was attracted by the great resoures of the Northwest. From a business of about $31,000 a year the E. P. Allis Co. has grown until the yearly output is between $4,000,000 and $5,000,000. The company manufatures everything in the engine line from 10,000 h. p. down to the smallest ordinary powers. The company has acquired equal reputation for its flour mill, saw mill and mining machinery, which is used in every quarter of the globe. Its branch offices are in all the large cities of the country.

The Milwaukee Engineering Co., St. Paul ave., Milwaukee, manufactures a medium grade of bicycles for the jobbing trade. The plant is extensive and is equipped with all modern tools used in the construction of bicycles. The aim is to put out a wheel which is stylish in design, appearance, finish, serviceable and thorough in its construction at a cost which will permit it to be retailed at $25. The guarantee extends over a period of one year. In the past three years over 75,000 wheels have been shipped to all parts of the United States and abroad.

The Hendee Wire Brush Co.—This company was incorporated at Milwaukee in 1895 to manufacture flexible back wire horse brushes. Since then the plant has been enlarged and now manufactures horse, cattle, butchers', painters', rotary power and railroad track brushes. The Hendee Wire Brush Co. is selling goods all over the United States and has an extensive export trade, including shipments to England, France, Italy, Australia and the Sandwich Islands.

H. P. Spalding, Pabst Bldg., Milwaukee, established a business in steam specialties seven years ago and though most of these years have been a time of depression, he has built up a strong business and counts among his customers some of the largest manufacturers in the country. His chief specialties are the Cookson feed water heater, the Anderson improved steam trap, and the Northwestern automatic smoke preventers. He also handles the Bates, Corliss and Watertown high speed engines and belting.

H. Mooers Co.—This business is one of the oldest in Milwaukee and has a very large plant located at the corner of Second and Sycamore sts. The Mooers Co. has to-day the largest establishment of its kind in the state, having a fine reputation for its steam, hot water heating and ventilating plants. The company is state agent for the Hawley down draft furnace, a well-known smoke consumer and coal economizer. It carries also a full line of iron pipe, valves, fittings, and engineers' supplies. To the sagacity and push of Mr. W. K. Downey, president and manager, and Mr. Thomas E. Hoye vice-president and superintendent, is largely due the firm's success.

Fred Sprinkmann, with a factory at 131-133 Sycamore st., manufactures magnesia and asbestos sectional and plastic coverings. Asbestos paper, mill board, hair felt, mineral wool and asbestos cement are also among the products.

B. Hoffman Mfg. Co.—This company operates a large iron and brass foundry and machine shop and is an extensive handler and fitter of wrought iron pipe for steam, gas and water. Other specialties are engine and boiler trimmings, steam and rotary pumps, mills, engineers and steam fitters supplies. The shops are at 606-624 Cedar st., and the offices 257-259 Sixth st., Milwaukee.

The Shaw Steel Casting Co.—The principal product of this concern is crucible steel. The plant is located at Milwaukee, Wis. Mr. T. H. Rice is manager.

Lubenow & Kohls Co., manufacturers of a large line of machine screws. Special screws are also a part of the business and are made from specifications. The offices are located at 592 First ave., Milwaukee, Wis.

The Wm. Bayley & Sons Co. are general founders and machinists. Foundry and architectural iron work is also done. The concern is located at 732-766 Greenbush st., Milwaukee, Wis.

Gardiner, Campbell & Sons, located at 238-256 Oregon st., Milwaukee, are proprietors of the Centennial Bell & Iron Works. They manufacture church, school, fire alarms, tower and all classes of bells, of genuine bell metal. The concern is one of the oldest in the West, and cast the largest bell but one ever made.

Milwaukee Boiler Co. was incorporated in June, 1890, with $100,000 capital and is a consolidation of the Marine Boiler Works, conducted by R. Davis, and the Wisconsin Boiler Works. Edwin Reynolds is president; James S. Church, vice-president; B. T. Leuzarder, secretary; Wm. W. Allis, treasurer; Charles Allis, assistant treasurer; Edgar Piercy, superintendent. The plant, which is one of the largest and best equipped in the West, covers 150x200 feet on Oregon st., and the product of from 150 to 200 employes is shipped all over the United States and to foreign countries. A large stock of boilers of every description is kept on hand.

The Fuller Warren Co., has offices and works at 32d st. and North ave. The business was established in 1832, at Troy, N. Y., and removed to Milwaukee in 1890. The celebrated P. P. Stewart stoves and ranges are manufactured on an extensive scale, the plant covering about eight acres. Steam and hot air furnaces are also manufactured. H. A. Viets is president; C. L. Graves, vice-president; C. W. Jones, secretary, and J. L. Potter, treasurer.

The Milwaukee Leather Belting Co., 136 Sycamore st., was established six months ago with E. W. Sikes, as manager. Mr. Sikes was formerly with W. S. Nott & Co., of Minneapolis. He was for nine years on the road and has spent eight years in manufacturing. The concern deals in belting and mill supplies, and carries a complete stock. Machines for repairing rubber and leather belts are included.

RACINE.

The George Gorton Machine Co., manufacturer of the highest grade of fine machine tools and small tools, was incorporated June 5, 1895. A specialty is made of disc surface grinding machines, one of which was recently illustrated in these columns. Another noteworthy specialty is the Taylor, Taylor & Hobson patent engraving machine, one of the most accurately made of small machine tools, and suited to general engraving. It is in use by many firms in Europe as well as in this country, almost every government in Europe having one or more in use. The company also makes special gauges, surface plates and all similar work.

Racine Fire Engine Co., Ltd.—This company manufactures everything in the fire engine line except steam fire engines. The firm has been in business five years and its output now goes all over the country and has quite a foreign market. R. B. Sigafoos is president and treasurer, J. Schroeder, vice-president, C. D. Vaarel, secretary and general manager and W. E. Smith, superintendent.

J. I. Case Plow Works.—This concern was established in Racine, Wis., in 1875, and was incorporated in 1885. The products are plows, cultivators, harrows, and kindred lines of farm implements, which have made the company known throughout the West and Northwest.

The Belle City Bolster Spring Co.—This concern is located at Racine, Wis., and manufactures bolster springs for wagons, etc. The business has been growing steadily.

The Racine General Mfg. Co., of Racine, manufatcures wagon, buggy and saddlery hardware, and all kinds of agricultural implements. They have several important specialties in these lines. M. Higgins, Jr., is president, and J. F. Bickel, secretary and treasurer.

The S. Freeman & Sons Mfg. Co., of Racine, operates a foundry machine shop and boiler works. The Strowbridge broad cast Sower and the Centennial fanning mill are the specialties of the company in implement lines, but it is best

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It is entirely possible (though not probable) that our price for a COCHRANE HEATER will be that much higher than what others will sell some other heater for. We charge according to what we furnish, and we endeavor to furnish the best.

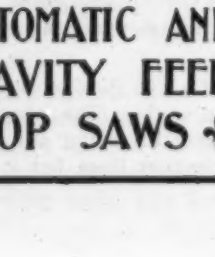
One can buy a full roast dinner for fifteen cents, but many of us (and possibly the fellow who ate that dinner) prefer something a little better, even if it does cost more.

Think This Over for a Minute.

Suppose we make our heaters a little easier to clean than others make theirs—isn't that worth something? Would $10 cover the difference if your engineer saved half an hour every time he cleaned, and if he cleaned three or four times oftener during the year, just because it wasn't so confounded hard to do after all? Suppose that we, by presenting more surface, by putting it in the proper place, etc., kept one thirty-second of an inch of scale from building up inside of your boilers every three months, or every year, would that save $10 worth of coal, and $10 worth of perspiration scraping it off (if it ever was removed)?

If our Oil Separators (there is a Cochrane Oil Separator on every Cochrane Heater) are a little bit more efficient than any other similar appliances, would you be willing to part with an extra "X" on that account?

*And now, if we give you a heater that would hold a few more gallons of water above the pump suction than the purchase you were thinking of making on account of that $50 difference, and if we furnished you with first-class valves and fittings, when we could possibly have skimped a few dollars in this direction, would it pay you to pay us $10 more for these advantages? Supposing so don't make it so—we are just as likely to ask $100 more (according to what the other fellow bids), but the difference is there for you. * * * You get something worth the money, basing the estimate on our price to you.*



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known to the iron trade for its boilers, which have an excellent reputation.

The Racine Malleable & Wrought Iron Co.—This concern manufactures malleable and gray iron castings and also specialties. J. P. Davies is president of the company. Important extensions have been made to the plant in the past year and the business has been steadily expanding.

The Gunther Co., located at 600-602 Sixth st., Racine, Wis. manufactures kerosine, crude oil and gasoline engines; general machinist work and blacksmithing is also done. The officers are H. Gunther, president; F. W. Gunther, vice-president, and E. Gunther, secretary and general manager.

The Racine Wagon & Carriage Co. is located at Racine, Wis., and manufactures buggies, carriages, spring wagons, express and delivery wagons, trucks, etc. Officers are H. E. Miles, president; A. T. Himes, secretary; J. C. Lund, treasurer; and J. T. Ryan, superintendent.

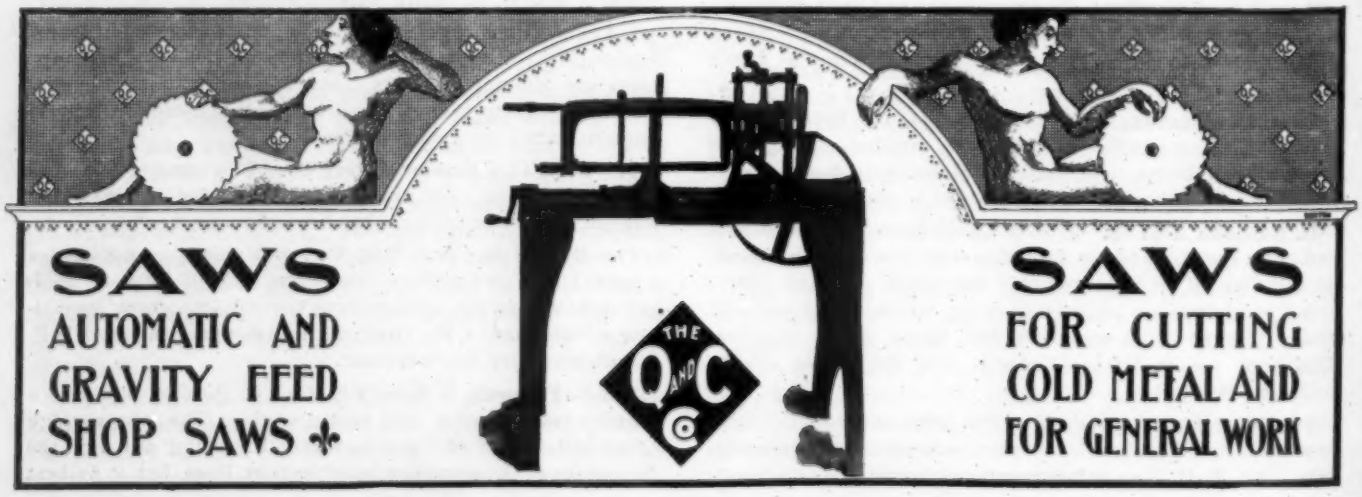
E. B. Adams & Son, of Racine, manufacture bolster springs, and are general joboers of hardware specialties.

OTHER WISCONSIN CITIES.

The Lippert Iron Works are at the corner of Exchange and Wisconsin sts., Kenosha, with Chicago office at 71-73 Market st. This concern operates a foundry and machine shop. Machinery and castings of all kinds are produced and special machinery is built to order.

Wiedenbeck, Dobelin & Co., Madison Wis., are jobbers in iron, steel, horse nails, wagon makers' and blacksmiths' supplies, plow stock, etc. This firm is doing a thrifty business and in less than three years has doubled its capacity. Shipping facilities are excellent, there being nine railway lines out of Madison, and 27 trains daily. The business of this firm is handled entirely by young men, who have made the prompt filling of orders a prime principle.

The Northwestern Wire Mattress Co.—This is a name familiar to dealers in metal beds, folding beds and wire mattresses. The factory, located at Kenosha, Wis., is capable of a very large daily output, yet for years its enlargement and improvement have compelled almost continuous attention.



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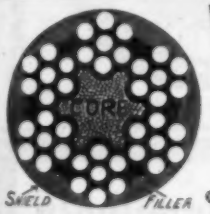

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The Kent Lubricant Co.—This concern was located at Waukesha, Wis., in 1897, for the manufacture of scientific lubricants. The principal products are Kent's lubricating compound, for shafting, etc., Kent's motor compound, Kent's axle dressing, bicycle lubricant, and Kent's harness dressing. E. K. West is president of the company, and H. W. Kent, vice-president. The Kent process is based on the principle that mineral oil properly combined with animal oil secures the viscosity of the one and the resisting power of the other.

Ladewig Bros. are located at Waukesha, Wis., the business being carried on by W. E. Ladewig. A. W. Ladewig, the other partner, retiring in 1896. Ladewig Bros. rebuild, buy and sell second hand machinery, engines, boilers, steam pumps, etc. Another line is sheet metal stamping and pressing department, making a specialty of stampings for saddlery manufacturers. The total business for 1898 was 14 times that of 1894-the first year.

The E. Kunert Mfg. Co.—This company is located at Watertown, Wis., and has officers as follows: E. Kunert, president; A. Tanck, vice-president; F. A. Hoffman, treasurer; and C. Kunert, secretary. Their business includes engineering, bridge building, contracting and iron and steel structural work of all kinds. The plant includes foundry, machine shop and boiler works; the products embracing boilers tanks, engines, pumps, special machinery, and pulley molding machines.

The Windsor Spring Co.—This concern, located at Kenosha, Wis., manufactures all-steel-spring beds, upholsterers' springs, and wire specialties of all kinds. Shipments are made all over the United States, Canada and Mexico, and trade has increased to such an extent that a new factory is now building which will have all the latest improvements. B. F. Windsor is treasurer and manager.

The Northwestern Iron Co.—This concern is of fifty years standing; the first furnace having been erected at Mayville, Wis., in 1848. The dimensions of the furnace are: Height, 77 feet; diameter of bosh, 17 feet; hearth, 10 feet; and its capacity is 200 tons daily. The products are foundry, high

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King & Walker Co., located at 613-623 E. Main st., Madison, Wis., employs a large number of men in its foundry and machine shop. Steam equipment of all descriptions—boilers, pipes and fittings—are the specialties. Besides these the company manufactures the Prouty and Monona printing presses, which have had an extensive foreign sale. Another portion of the business is the re-flueing and rebuilding of boilers of every description. A line of punching and power presses is also manufactured, some of them having been shipped to Germany.

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The Taylor & Morris Co.—This concern is one of the important institutions of Janesville, Wis. The manufactures are power boiler feed pumps, gray iron and brass castings. The officers are G. W. Marsden, president, and R. H. Morris, secretary and treasurer.

Waukesha Malleable Iron Co., of Waukesha, Wis., is engaged in the production of malleable iron specialties. In the past year and at the present time the demand upon the plant has compelled its operation to its utmost capacity.

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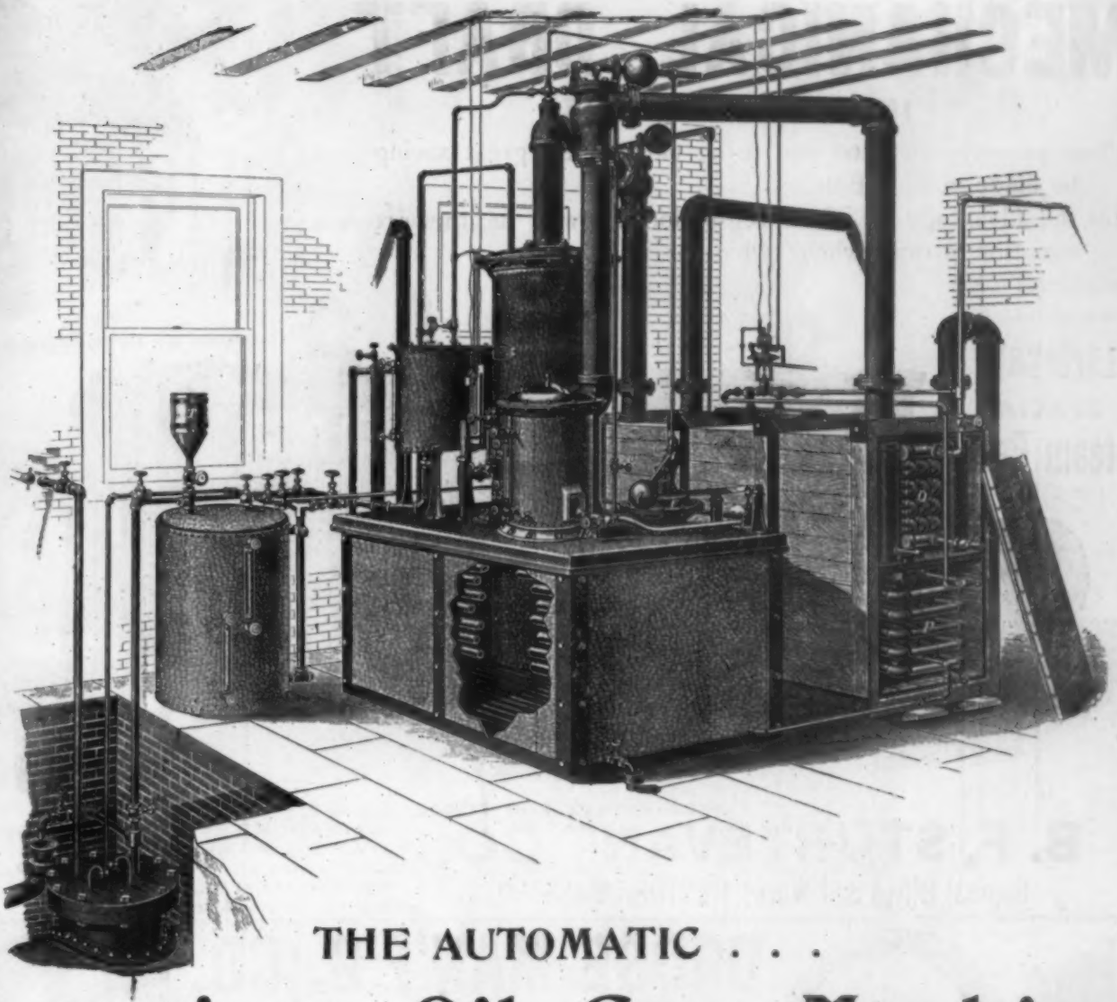

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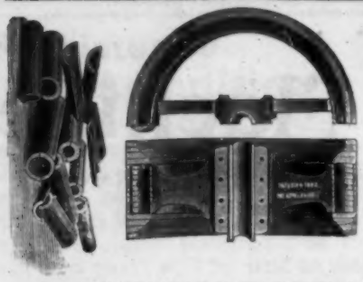

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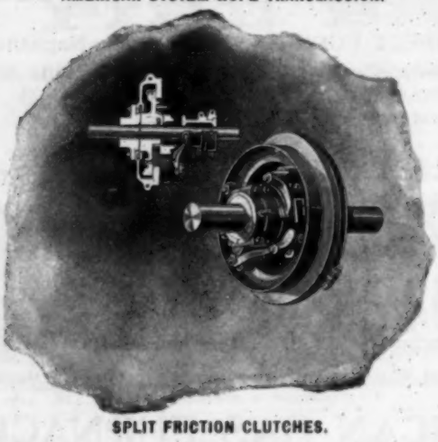

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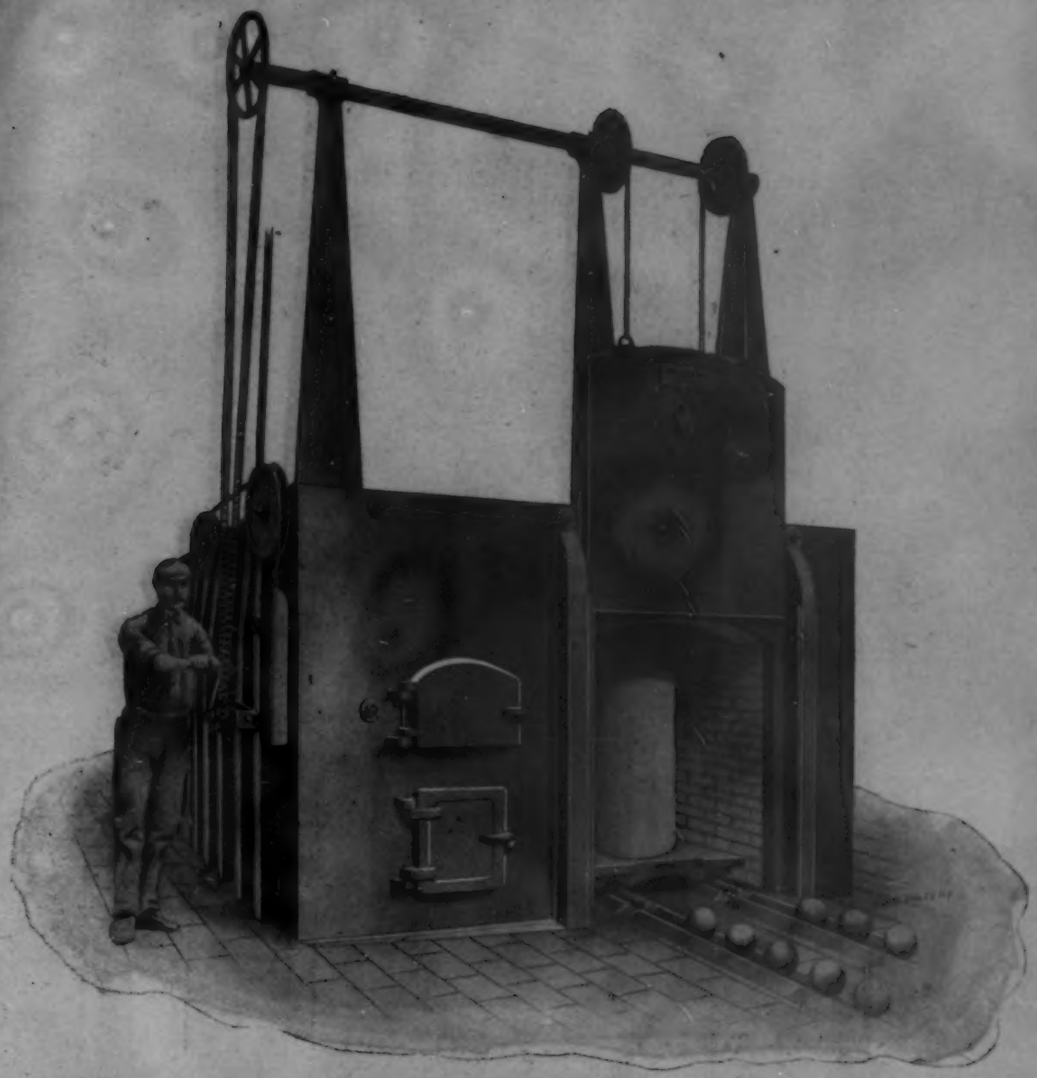

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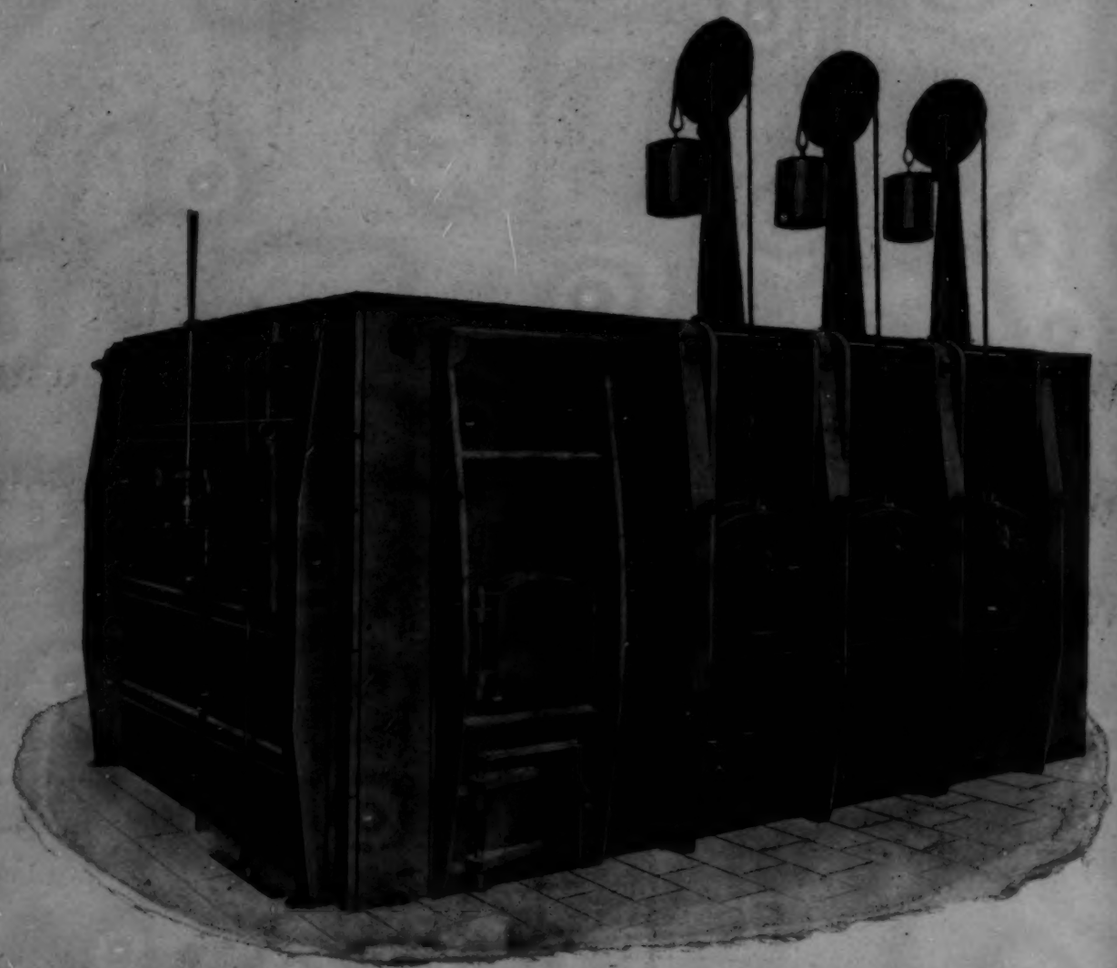

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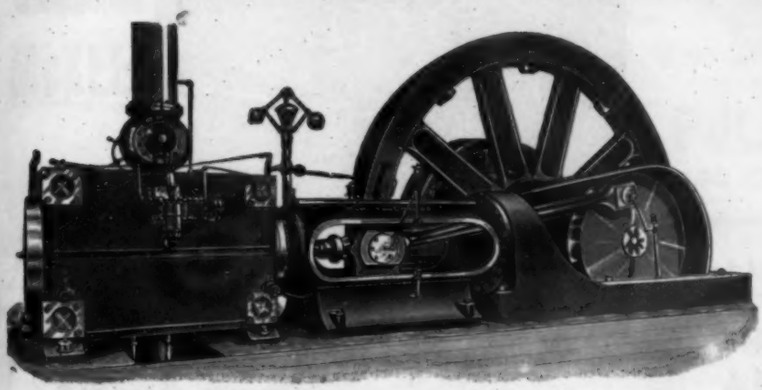

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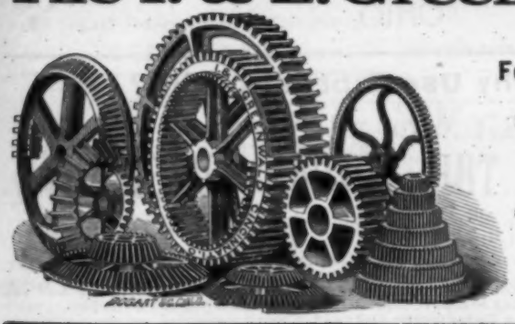

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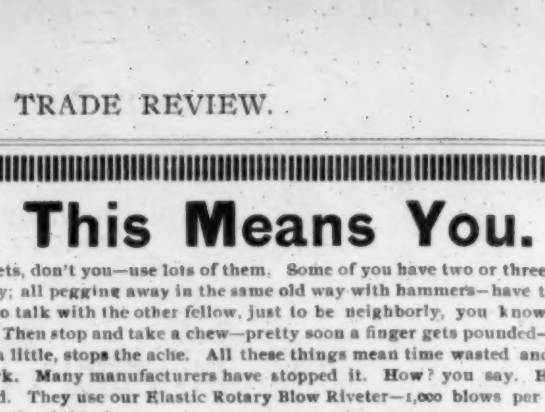

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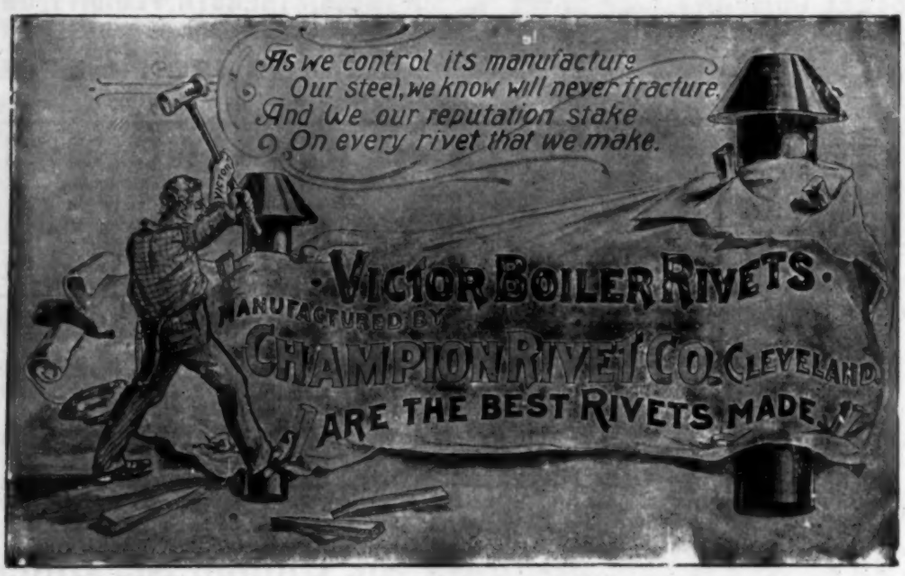
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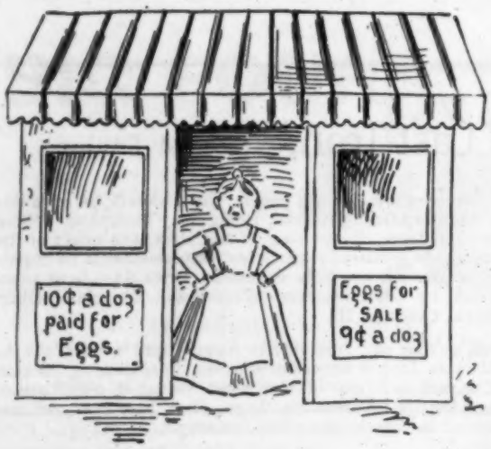

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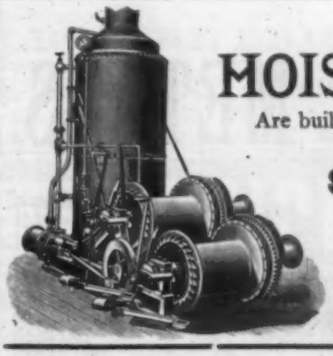

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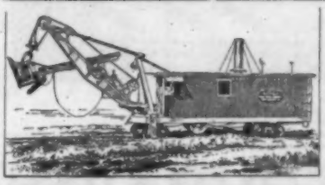

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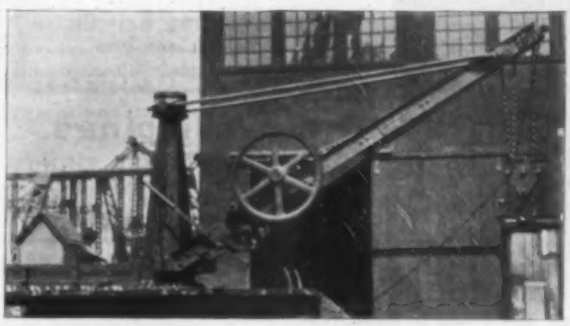

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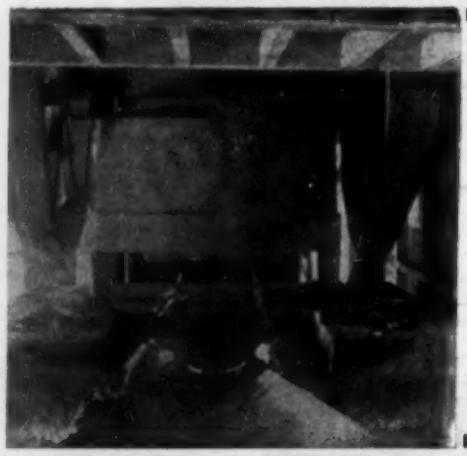
WE GUARANTEE to place all Plants erected by us in successful operation.



ROBINS BELT CONVEYORS
are the best for handling.....
ORE, COAL, COKE AND LIMESTONE.
Cut shows Belt Conveyor used to carry limestone from crusher at N. J. Zinc Co., Franklin Furnace, N. J.
Catalogue mailed on application.
Robins Conveying Belt Co.,
147-149 Cedar St., NEW YORK.

OUR
Pressure Filters
For Boiler Service
keep the sediment and mud out of the boilers.
THE WE FU GO COMPANY,
Smith and Augusta Streets,
CINCINNATI, O.

Press Clippings.
If you want THE BEST THINGS printed on any particular subject or ALL that is published about it everywhere, YOU CAN GET IT FROM US. Clippings mailed daily.
We read practically every newspaper and periodical that is published. Business men and others find our service very valuable to them. Rates, $1 per month and upwards.
Write for particulars.
The Chicago Press Clipping Bureau.
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CREMER & BICKNELL, . . Chemists and Metallurgists, . . 24 Superior St., Cleveland, O.
Analytical and Testing Laboratory.
Reports on chemical and metallurgical processes. Analyses of ores, metals, fuels, railroad and foundry supplies, etc. Assaying—Gold, silver, copper ores. Mechanical Tests of Iron, Steel, etc. Our Testing Machine has been standardized by Insp. of Ordnance, U. S. A., for use on government work.

SHIFFLER BRIDGE COMPANY,
BUILDING DEPARTMENT.
SPECIALTIES: Steel and Iron Buildings for Rolling Mills, Tin Plate Plants, Steel Works, Foundries, Factories, Roof Trusses, Girders, Columns, Beams, Corrugated Iron, Etc.
Main Office and Works:
48th Street and A.V. Ry., PITTSBURG, PA.
Branch Offices:
1214 Betz Building, Philadelphia, Pa.
45 Broadway, New York, N. Y.
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Roller, Steel and Special Chains.
ELEVATORS
AND
CONVEYORS
FOR HANDLING MATERIAL OF ALL KINDS.
WIRE CABLE CONVEYORS.
THE JEFFREY MFG. CO. Columbus, Ohio.
41 DEY STREET, NEW YORK.
SEND FOR CATALOGUE

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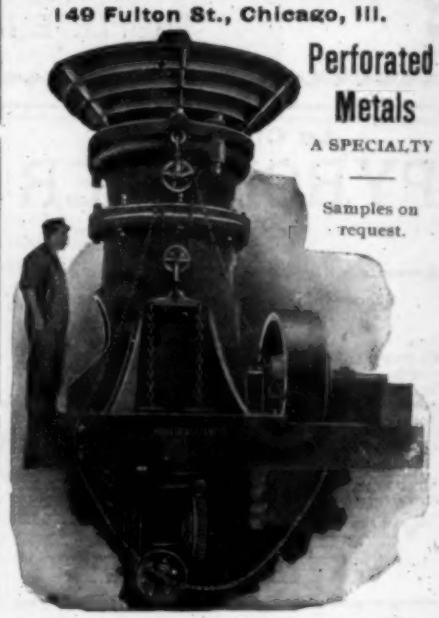

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Samples on request.
Comet Adjustable Rock Crushers, Mining Machinery, Stamp Mills, Smelters, Hoisting Engines.
SOLE MAKERS OF RIEDLER PUMPS.

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WOOD ENGRAVING
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The Chemical Analysis of Iron, $4.00.

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MANUFACTURED BY

THE CLEARFIELD FIRE BRICK CO., Limited,

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FIRE DOVER FIRE BRICK CO., MANUFACTURERS OF Furnace, Mill and Special Shape Fire Brick. Office, 44 Mercantile Bank Bldg., CLEVELAND, OHIO. **BRICK**

FIRE BRICK For All Purposes.

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ÆTNA FIRE BRICK COMPANY,

Manufacturers of the Celebrated

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Office and Works: OAK HILL, OHIO.

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Stripping Plate Machines Operated by Steam or Compressed Air.

Our new air power vibrator machine gives all the advantages of stripping plate work, without the cost of stripping plates.

Write us about low cost of pattern installation. Wood or metal patterns used.

THE TABOR MFG. CO., Elizabeth, N. J.

Millett's Patent Portable

Core Oven

All complete and ready to put the fire in. No one who makes small cores can afford to be without it. . .

DOUBLE DOORS.

One closing the oven when the other is open.

Saves Fuel, Saves Time.

Send for Circular.

MILLETT CORE OVEN CO., Brightwood, Mass.

The Core Ovens may be seen in the sample rooms of The S. Obermayer Co., either in Cincinnati or Chicago. J. W. Paxson & Co., Philadelphia, Pa.

FIRE BRICK

Holmes, Strachan & Co.,

Manufacturers and Shippers

Steel
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Best made for Malleable Rolling Mill Furnaces and Cupola Linings.

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B.F.S.Co's Flasks are **All Right** so **Are Prices.**

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LATEST AND BEST.

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Selling Agents FOR Brass Founders Supply Co.: THE S. Obermayer Co. Cincinnati and Chicago. J. W. Paxson Co. Philadelphia, Pa. J. S. McCormick Co. Pittsburgh, Pa.

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Foundry Facings,
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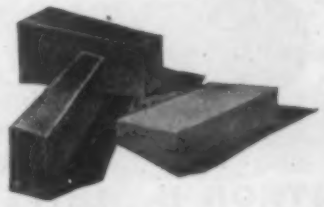
Estimates given on complete Brass & Iron Foundries. Send for Catalogue No. 26.

Fire Brick, Cupola Blocks, Molding Sand and General Foundry Supplies

OF THE HIGHEST GRADE ONLY.



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"Royal Star" and "Scioto Star"

High Grade FIRE BRICK.

TRADE MARK SCIOTO

Best for Rolling Mills, Blast Furnaces, Foundries, etc. High grade Plastic and Flint Clays for all refractory purposes at favorable prices.

The Scioto STAR Fire Brick Works.

PORTSMOUTH, OHIO.

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Established 1871.

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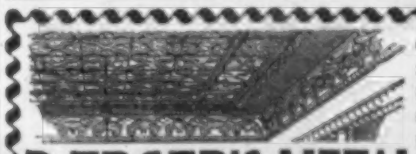

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Deepest stamped. Most artistic. The only ones in Classified Designs. Write to-day for details. THE BERGER MFG. CO., Canton, O.

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MAKERS OF

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Office and Warerooms, 28 Columbus St.

Factories on Columbus, Winter and Leonard Sts.

Cleveland, Ohio, U. S. A.

BRÆBURN STEEL COMPANY, Bræburn, Pa.
MANUFACTURERS OF
FINE TOOL STEEL AND FORGINGS. ALSO SPRING HAMMER, AND MACHINERY STEEL OF HIGH QUALITY. FINE OPEN-HEARTH STEEL.

DIRECTORS:
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MORE WEAR from your tools
.....Almost no **STEEL EXPENSE**
NO TROUBLE

"It pays to use the most reliable tool steel in the market."

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CRESCENT STEEL
ESTABLISHED 1865 ✱ INCORPORATED 1888.
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480 PEARL ST. NEW YORK — PITTSBURGH, PA. — 64 & 66 S. CLINTON ST. CHICAGO.

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MANUFACTURERS OF FINE
CRUCIBLE CAST TOOL STEEL.
SPECIAL GRADES FOR ALL PURPOSES.
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COLD ROLLED STRIP STEEL
FLAT & COILED FOR STAMPING DRAWING BLANKING SPRINGS ETC
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Don't Waste Money in Your Pattern Shop.
THE GOBEILLE PATTERN CO., Cleveland.

Burst Water Pipes
A Thing of the Past.

You can now make all water pipes as secure from bursting in winter as in summer. This pneumatic system is the only one which successfully prevents the annoying and costly bursting of water pipes. It has solved a great economic problem. Highly indorsed by architects, engineers and municipal officials.

No new house should be completed without this system, and all house owners should avail themselves of this "ounce of prevention" in season.

Send for illustrated booklet, giving full explanation.

This double slope causes the expanding ice to slide into the air dome taking the strain off the pipe. The air cushion also prevents "hammering." Covered by United States and Foreign Patents.

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68-74 West Monroe St., Chicago.
Best Bronze, Babbitt Metals, Brass and Aluminum CASTINGS On Short Notice.

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IRON ORE.

[On Lake Erie docks.]

Special low-phosphorus hard Ore, Bessemer	$3.75
No. 1 Specular, Bessemer	$3.15@3.50
No. 1 Bessemer hematite	2.75@3.25
Hematites No. 1 non-Bessemer	1.90@2.10
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PIG IRON.

CLEVELAND (f. o. b. cars):	
Bessemer	$15 15
No. 1 Strong Foundry	$15 65@16 00
No. 2 Strong Foundry	15 15@15 40
Gray Forge, red short	14 65
Gray Forge, neutral	14 40
No. 1 American Scotch	15 75@16 00
No. 2 American Scotch	15 40@15 65
Lake Superior Charcoal	16 50@17 00
PITTSBURG:	
No. 1 Foundry	$15 75@16 00
No. 2 Foundry	15 50@15 75
Gray Forge	14 25@14 50
White and Mottled	13 50
Warm Blast Charcoal	15 00@17 00
Cold Blast Charcoal	22 00@26 00
Bessemer	15 15@15 25
CHICAGO:	
Lake Superior Charcoal	$17 00@18 00
Local Coke Foundry No. 1	15 50@15 75
Local Coke Foundry No. 2	15 00@15 50
Local Coke Foundry No. 3	14 50@14 75
Local Scotch Foundry No. 1	15 50@15 75
Local Scotch Foundry No. 2	15 00@15 50
Local Scotch Foundry No. 3	14 50@14 75
Southern Coke No. 1	16 00@16 25
Southern Coke No. 2	15 25@15 75
Southern Coke No. 3	14 75@15 00
Southern No. 1 Soft	15 50@16 00
Southern No. 2 Soft	15 00@15 50
Southern Silveries	15 50@16 00
Jackson Co. Silveries	17 00@18 00
Ohio Silveries No. 1	@
Ohio Strong Softeners	15 50@16 50
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Southern Coke No. 1, Foundry	$14 75@15 25
Southern Coke No. 2 and No. 1 Soft	14 25@14 75
Hanging Rock Charcoal No. 1, Fdy	17 00@18 00
Tennessee Charcoal No 1	15 00@16 00
Jackson County Silvery No 1	16 00@16 25
Southern Coke, Gray Forge	12 75@13 00
" " Mottled	12 75@13 00
Standard Georgia Car Wheel	15 50@16 00
Lake Superior " "	15 50@16 00
BUFFALO:	
No. 1 Foundry Strong Coke Iron Lake Superior Ore	$14 25
No. 2 Foundry Strong Coke Iron Lake Superior Ore	13 75
Ohio Strong Softener No. 1	14 00
Ohio Strong Softener No. 2	13 50
Jackson Co. Silvery No. 1	15 60
Southern Soft No. 1	15 25
Southern Soft No. 2	14 75
Lake Superior Charcoal	14 00@14 50
Coke, Malleable	14 10
ST. LOUIS:	
Southern Coke No 1	$14 75
Southern Coke No. 2	14 25
Southern Coke No. 3	13 75
Southern Coke No. 4	13 50
Southern Gray Forge	13 20
Tennessee Charcoal No 1	13 75
Jackson County 2 per cent Silicon	16 25
Lake Superior Coke No. 1	15 00@16 00
Southern Car Wheel	15 25@16 25
Genuine Connellsville Coke	4 15
West Virginia Coke	4 10

OLD RAILS AND SCRAP METAL.

[Delivered Cleveland.]	Gross Tons
Old iron rails	$18 00
Old steel rails (6 ft. and over)	14 00
Old steel rails (6 ft. and under)	14 00
Old car wheels	6 00
	NET TONS
No. 1 R. R. wrought scrap	36 00
Mill scrap	11 50
No. 1 Machine cast scrap	12 50
Iron axles	19 00
Axle turnings	11 00
Wrought turnings (free from cast)	10 00
Cast borings	7 50
Uncut wrought iron boilers	7 00
Steel boiler plates	11 00
Grate bars	8 00
Pipes and flues (clean)	10 00
Tank iron	12 00
Hoop and band iron	9 00
Sheet iron	8 00
Wrought drillings	10 00
Malleable iron	10 50

STRUCTURAL MATERIAL.

Beams and Channels (f. o. b. Cleveland)	1.50c
Angles	1.50c
Tees	1.50c
Universal Plates	1.80@1.90c
Sheared Plates	2.00c

MERCHANT IRON AND STEEL.

[Less than car-lots, Cleveland.]
Rounds and Squares.—Bar Iron.

1 to 1¾	1.50 Base.
2 to 2¾	.20 extra.
3 to 3¾	.50 "
3¾ to 4	.80 "
4¼ to 4¾	1.00 "
4¾ to 5	1.30 "
5¼ to 6	1.50 "
5¼ to 6¼	2.00 "

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3,500 Acres of Coal.

5,000 Tons Daily Capacity. 350 Individual Coal and Coke Cars.

YOUGHIOGHENY COAL
For Steel Works, Rolling Mills, Tin Plate Works, Locomotive Fuel, etc.

COKING COAL
For Bee Hive or By-Product Ovens.

Our WASHINGTON COKE
Is unsurpassed for uniform purity and general satisfaction in **Blast Furnace and Cupola Practice.** Quality and prompt attention to shipments insure us the preference.

General Office,
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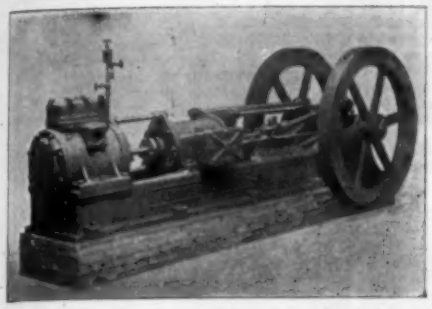

Air Compressors
for Air Lift Well Pumping.

Air Compressors
for Rock Drills, Coal Cutters, Air Hoists and Pneumatic work generally.

Pressure Pumps
for Cotton Oil Mills and Cotton Compressors.

Steam Pumps,
Single and Duplex, of all sizes and for all purposes.

Duplex and Triplex POWER PUMPS.

CORRESPONDENCE SOLICITED.

HALL STEAM PUMP COMPANY, Pittsburg, Pa

Who builds the best Mine Pump?

PRESCOTT.

Fred. M. Prescott Steam Pump Co.,

MILWAUKEE, WIS.

ATTENTION, FOUNDRYMEN!

The Perfection Core Boxes are Perfection and You Should Use Them.

Plumbago.

No dowel pins to break off, no holes to clean out; the shifting of the box endwise serves to loosen the core, consequently no rapping, prolonging the life of the box.

C. F. M. Founders' Perfect Wash.

WE ALSO MANUFACTURE ALL KINDS OF **FOUNDRY FACINGS AND SUPPLIES**

Cleveland Facing Mill Co., 2 Carter St., Cleveland, O.

Established 1879.

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MOULDING SAND.

Our Sand is SECOND TO NONE. Banks at Conneaut and Kingsville. Samples and Prices on Application

Conneaut, Ohio.

Not every insertion of every advertiser's card brings an order for the advertiser's good; no more does every visit of the traveling salesman result in a sale.

There is a vast deal in familiarity with the type and phrase in which a manufacturer makes himself known to the advertisement reader, just as the personal acquaintance of his traveling salesman gets him a hearing when a strange face and a strange voice are bowed out with a "busy day's" courtesies.

The best advertisers, the most successful advertisers, the advertisers who get returns, are those who keep everlastingly at it.

This is a case in which familiarity breeds business.

LEVIATHAN

Belting

Is the strongest, runs the most evenly, and best adapted for Cotton, Woolen, Saw and Planing Mills, Brick and Tile Works and

Heavy Driving Generally.

MAIN BELTING CO.

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HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
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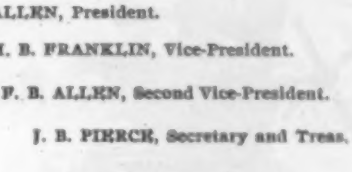

BURWELL & BRIGGS, General Agents, 32 and 33 Clark Bldg., 208 Superior St., Cleveland, O.

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To advertise in the Iron Trade Review.

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All standard and special grades.
In sectional molds or bars.

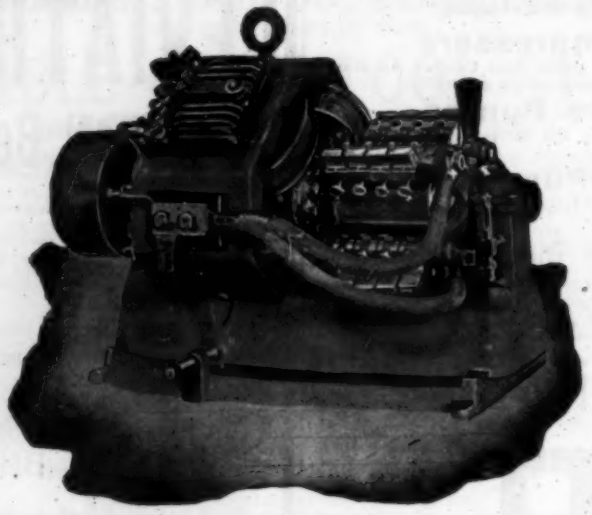
Phila Chicago. **MERCHANT & CO., Inc.** New York. Brooklyn.

Wrtte us for prices always. It will pay you.

Eddy Dynamo Electro-Plating Machines

— FOR —

BICYCLE PLATING PLANTS.



NORTHAMPTON EMERY WHEEL CO., 20 S. Canal St., Chicago, Ill.

EXCLUSIVE WESTERN SELLING AGENTS.

THE NEW FOX

Our No. 2 Hand Milling Machine.

Pilot Wheel Hand Miller,

Constructed on Generally Approved Lines, but Distinctively Exclusive in its

PILOT WHEEL CARRIAGE FEED, Exceedingly Handy for a

Long Stroke, Quick Return, and for Milling "Spats."

UNIVERSALLY ADJUSTIBLE SPINDLE BOXES.

(Spindle may be kept in original alignment.)

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We also have a new line of **SENSITIVE DRILLS**, 1 to 6 Spindle, and further, make **PUNCH PRESS SQUARING SHEARS, SHAPERS,** also **FOX UNIVERSAL TRIMMERS.**

313 N. Front St., Grand Rapids, Mich. **FOX MACHINE CO.**

THE 1898 EDITION OF THE Iron and Steel Directory

Published by
The American Iron and Steel Association.

Will be sent postpaid by *The Iron Trade Review* at $7. Ready now.

Is a thorough revision of the list of blast furnaces, rolling mills, Bessemer and Open-Hearth steel works, plate and sheet mills, nail mills, tin plate mills, malleable, cast iron pipe and wrought pipe works, car wheel and locomotive works, with many new lists of works in other lines.

6⅝ to 7¾	2.50 extra
¼ to ⅜	.10 "
⅝ to 11-16	.20 "
½ to 9-16	.30 "
7-16 to 15-32	.40 "
⅛ to 13 2	.50 "
5-16 to 1 -32	.70 "
¼ to 9-32	.90 "
7-32	1.40 "
3-16	2.50 "

Flats.—Bar Iron.

1¼ to 4 x ⅜ to 1	1.05 Base
4¼ o 6 x ⅜ to 1	.10 extra
6¼ o 8 x ⅜ to 1	.60 "
8¼ o 10 x ⅜ to 1	.80 "
1¼ o 4 x 1 1-16 to 1¼	.30 "
4¼ to 6 x 1 1-16 to 1¼	.40 "
6¼ to 8 x 1 1-16 to 1¼	.60 "
8¼ to 10 x 1 1-16 to 1¼	.90 "
2 to 4 x 1⅛ to 2	.50 "
4¼ to 6 x 1⅛ to 2	.60 "
6¼ to 8 x 1⅛ to 2	.80 "
8¼ to 10 x 1⅛ to 2	1.00 "
2 to 4 x 2⅛ to 3	.60 "
4¼ to 6 x 2⅛ to 3	.80 "
6¼ to 8 x 2⅛ to 3	1.00 "
1¼ to 1¾ x ⅜ to 1	.10 "
1 to 1 1-16 x ⅜ to ⅝	.20 "
¼ to 15-16 x ⅜ to ¾	.40 "
⅝ to 11-16 x ⅜ to ⅞	.50 "
¼ to 9-16 x ⅜ to ⅛	.90 "

Heavy Band Iron.

7 to 10 x ¼ to 5-16	.70 extra.
6¼ to 6¾ x ¼ to 5-16	.50 "
4¼ to 6 x ¼ to 5-16	.30 "
1⅝ to 4 x ¼ to 5-16	.20 "
1 to 1¾ x ¼ to 5-16	.30 "
¼ to 15-16 x ¼ to 5-16	.50 "
⅝ to 11-16 x ¼ to 5-16	.80 "
¼ to 9-16 x ¼ to 5-16	1.00 "
¾ to 7-16 x ¼ to 5-16	1.50 "

Heavy bands, 7-32 in. thick 1-10 c. per lb. higher than ¼ to 5-16 thick. **Bevel Edge Shaft Iron** 1-10 higher than same size of Heavy Bands.

Light Band Iron.

7 to 8 x No. 9 to 3-16	.90 extra
7 to 8 x Nos. 10, 11 and 12	1.00 "
6¼ to 6¾ x No. 9 to 3-16	.70 "
6¼ to 6¾ x Nos. 10, 11 and 12	.80 "
4¼ to 6 x No. 9 to 3-16	.50 "
4¼ to 6 x Nos. 10, 11 and 12	.60 "
1¼ to 4 x No. 9 to 3-16	.40 "
1¼ to 4 x Nos. 10, 11 and 12	.50 "
1 to 1 3-16 x No. 9 to 3-16	.50 "
1 to 1 3-16 x Nos. 10, 11 and 12	.60 "
13-16 to ⅞ x No. 9 to 3-16	.60 "
13-16 to ⅞ x Nos. 10, 11 and 12	.70 "
11-16 to ¾ x No. 9 to 3-16	.80 "
11-16 to ¾ x Nos. 10, 11 and 12	.90 "
9-16 to ⅝ x No. 9 to 3-16	1.00 "
9-16 to ⅝ x Nos. 10, 11 and 12	1.10 "
7-16 to ½ x No. 9 to 3-16	1.30 "
7-16 to ½ x Nos. 10, 11 and 12	1.40
⅜ x No. 9 to 3-16	1.50
⅜ x Nos. 10, 11 and 12	1.60

Bevel Edge Box Iron.

Same as Light Bands, of same sizes.

Beaded Band Iron, 1¼ in. to 2 in.

Sand Band Iron, 1-10 c. above same sizes of Light Bands.

Oval Iron.

⅜ to 1⅛	.40 extra
¼ to 13-16	.50 "
⅜ to 11-16	.60 "
½ to 9-16	.80 "
¾ to 7-16	1.10 "
½ to 9-16 x 3-16	1.00 "
⅝ to 11-16 x ¼	1.20 "

Half Oval and Half Round.

2¼ to 3	.60 extra
⅜ to 2	.50 "
¼ to 13-16	.70 "
⅜ to 11-16	.90 "
½ to 9-16	1.20 "
¾ to 7-16	2.50 "
5-16	3.50 "
¼	4.50 "

Half Ovals less than ¼ their width in thickness, extra price.

Horse Shoe Iron.

All sizes 1 c. extra.

Cutting ordinary bars to specified length, .20 to .30 extra, according to length and size.

Steel Bands.

Width In Inches.	English Standard Gauge.		Extras.
1 1-2 to 6,	Nos. 7, 8, 9 or 3-16 "	1.50 Base.	
1¼ to 6,	" 10, 11, 12 or ¼"	.05	per 100 lbs.
1 to 1¾,	" 7, 8, 9 or 3-16"	.10	"
1 to 1¾,	" 10, 11, 12 or ¼"	.15	"
13-16 and ⅞,	" 7, 8, 9 or 3-16"	.20	"
13-16 and ⅞,	" 10, 11, 12 or ¼"	.25	"
11-16 and ¾,	" 7, 8, 9 or 3-16"	.30	"
11-16 and ¾,	" 10, 11, 12 or ¼"	.35	"
9-16 and ⅝,	" 7, 8, 9 or 3-16"	.40	"
9-16 and ⅝,	" 10, 11, 12 or ¼"	.45	"
½,	Nos. 7, 8, 9 or 3-16"	.55	"
½,	" 10, 11, 12 or ¼"	.60	"
7-16	" 7, 8, 9 or 3-16"	.75	"
7-19	" 10, 11, 12 or ¼"	.85	"
⅜,	" 7, 8, 9 or 3-16"	.95	"
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Width Inches.	English Standard Gauge.		Extras.
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7-16 to 2,	" 17, 18, and 19	.05	per 100 lb
7-16 to 2,	" 20	.10	"
7-16 to 2,	" 21	.15	"
7-16 to 1½,	" 22	.25	"
½ to 1½,	" 13, 14 and 15	.05	"
½ to 1½,	" 16, 17 and 18	.10	"

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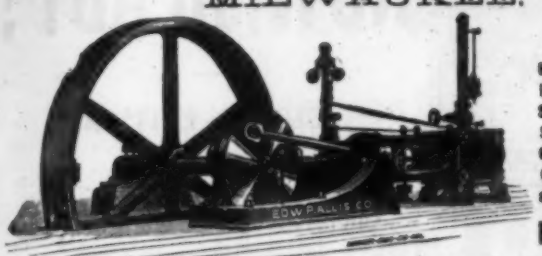

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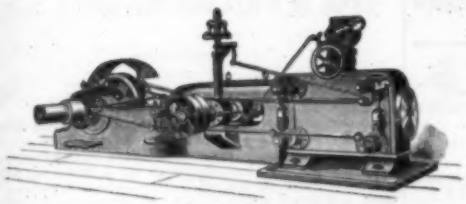

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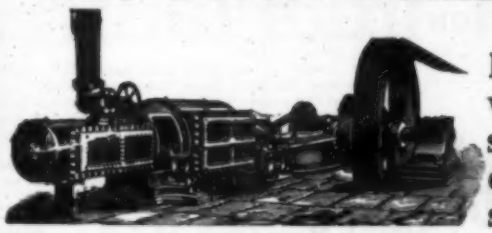

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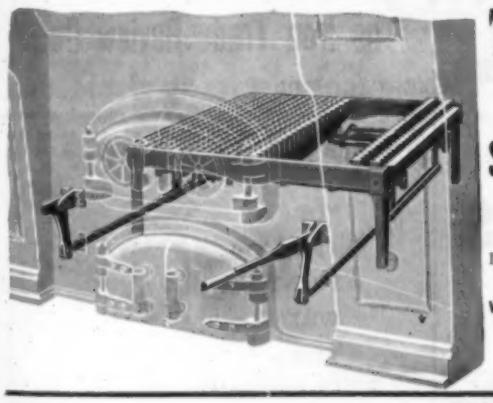

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15-16 and 1,	"	19 and 20	.20 "
15-16 and 1,	"	21	.25 "
15-16 and 1,	"	22	.35 "
⅞,	Nos. 13, 14 and 15		.20 "
⅞,	" 16, 17 and 18		.25 "
⅞,	" 19 and 20		.30 "
⅞,	" 21		.33 "
⅞,	" 22		.45 "
¾ and 13-16	Nos. 13, 14 and 15		.30 "
¾ and 13-16	" 16, 17 and 18		.35 "
¾ and 13-16	" 19 and 20		.40 "
¾ and 13-16	" 21		.45 "
¾ and 13-16	" 22		.50 "
¾ and 13-16	" 23		.60 "
11-16,	Nos. 13, 14 and 15		.35 "
11-16,	" 16, 17 and 18		.40 "
11-16,	" 19 and 20		.50 "
11-16,	" 21		.60 "
11-16,	" 22		.70 "
11-16,	" 23		.80 "
⅝,	Nos. 13, 14 and 15		.40 "
⅝,	" 16, 17 and 18		.45 "
⅝,	" 19 and 20		.55 "
⅝,	" 21		.65 "
⅝,	" 22		.75 "
⅝,	" 23		.85 "
9-16,	" 13, 14 and 15		.45 "
9-16,	" 16, 17 and 18		.50 "
9-16,	" 19 and 20		.60 "
9-16,	" 21		.70 "
9-16,	" 22		.80 "
9-16,	" 23		.90 "
½,	" 13, 14 and 15		.55 "
½,	" 16, 17 and 18		.60 "
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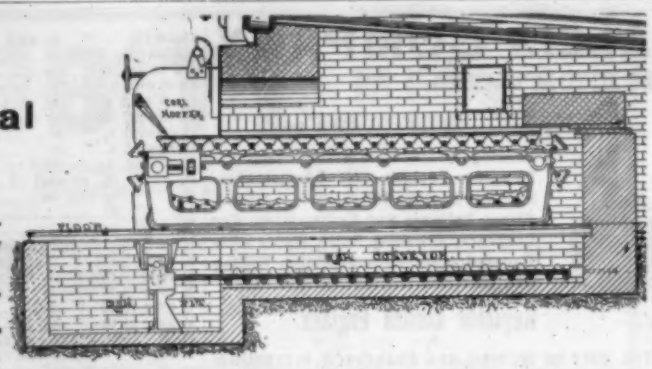

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EXTRACT FROM PREFACE:

In the preparation of the second edition of our Handbook, the general plan of the first edition has been followed, viz., to present in concise form such data and information as are useful to the chemist and metallurgist. Several tables of the first edition, which were of somewhat limited use, have been omitted, while more than one hundred pages of new matter have been added.

The methods for analysis of iron ore, iron and steel and for assaying have been given briefly, but perhaps as much in detail as is consistent with the general scope of the book. Several changes and additions to the Specific Gravity tables have been made by adoption of later and more accurate values.

In the notes on blast furnace practice have been outlined the more important theoretical and practical points, which, it is hoped, will be of some service to those interested in the manufacture of iron.

The hygrometric table gives the necessary information for determining the amount of moisture in air, a subject whose importance in metallurgical operations is being more fully recognized at present than heretofore. This table is new and is based on the most accurate data available at the present time.

The tables of weights and measures, United States and foreign, have been very much amplified, and the conversion tables for United States and metric weight and measures of the U. S. Coast and Geodetic Survey included, the latter being based on the legal standard for this country.

Numerous miscellaneous tables have been added, which, it is hoped, will be found of value

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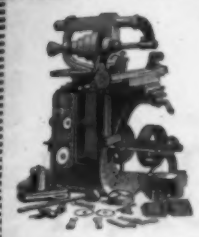

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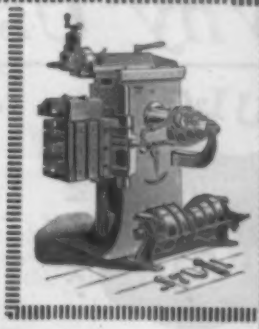

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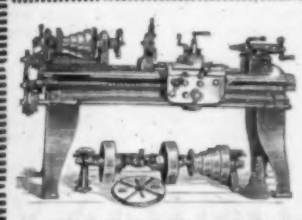

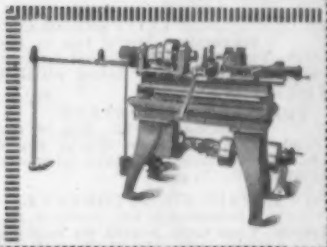

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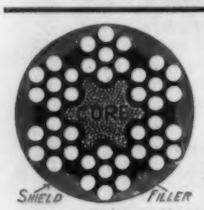

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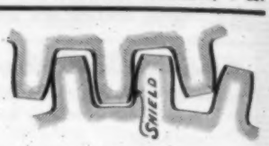

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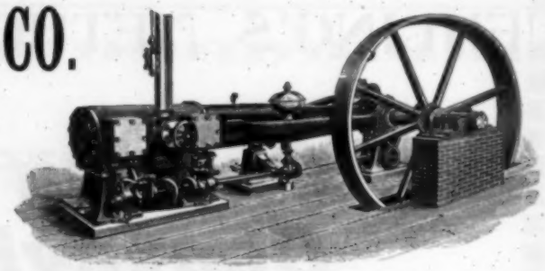

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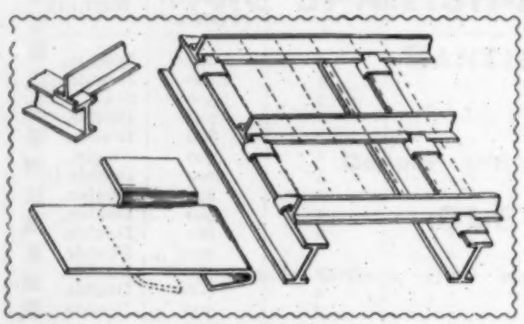

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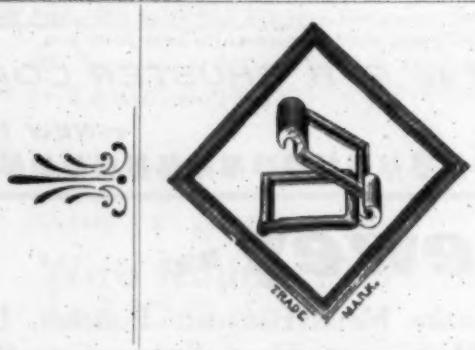

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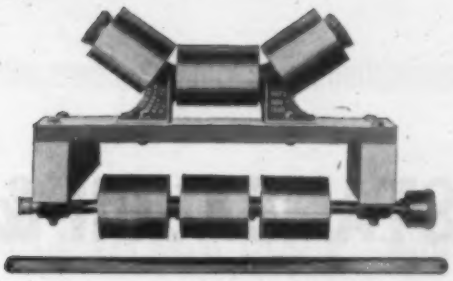

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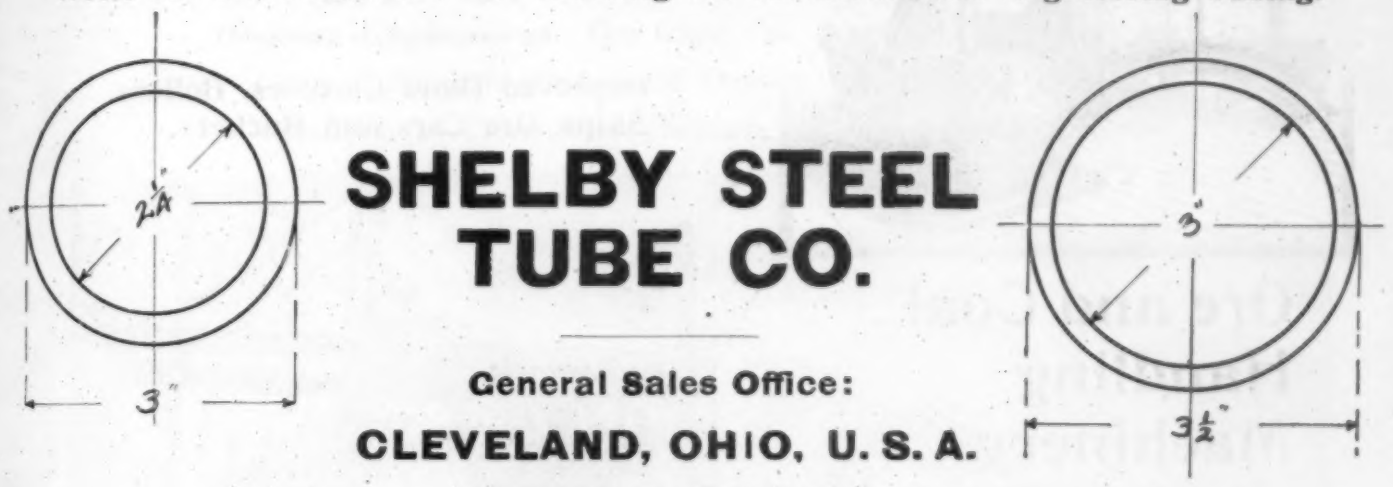

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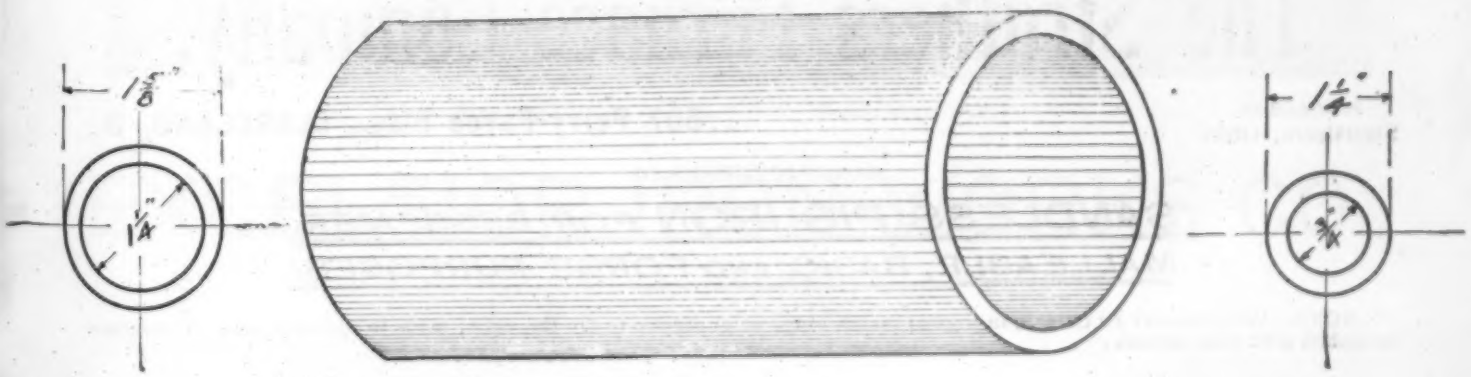

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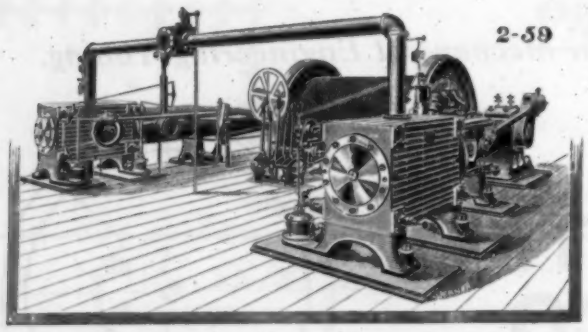

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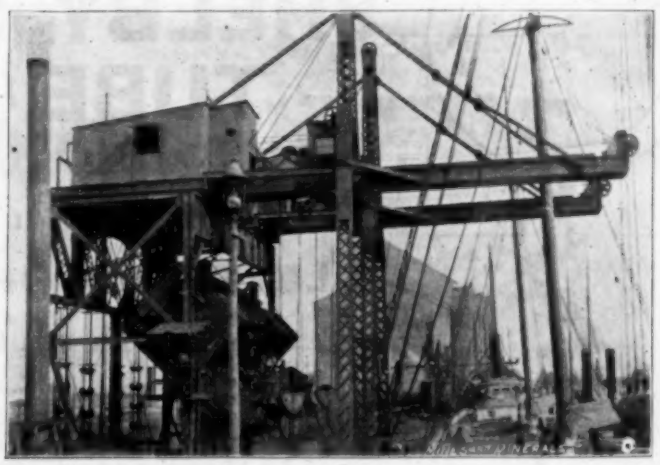

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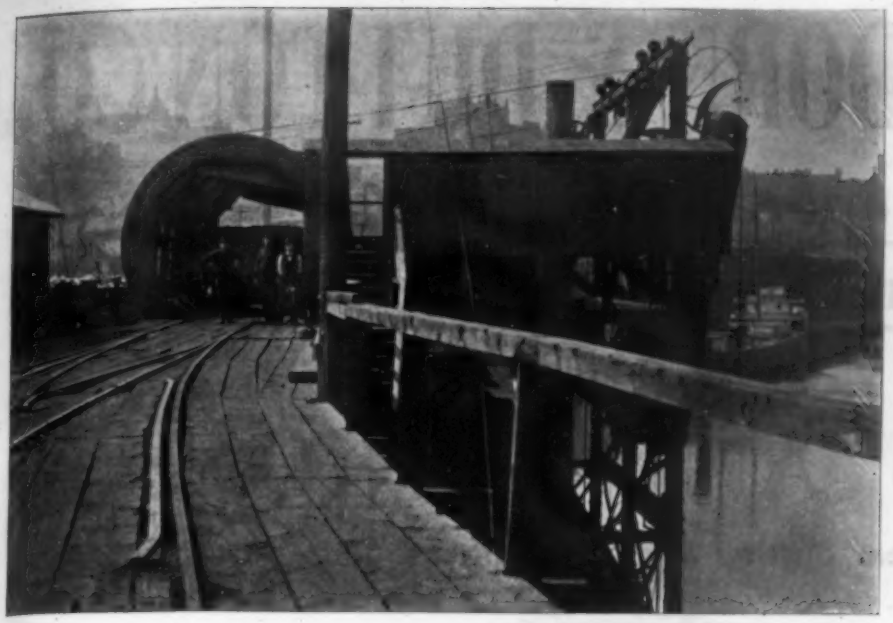

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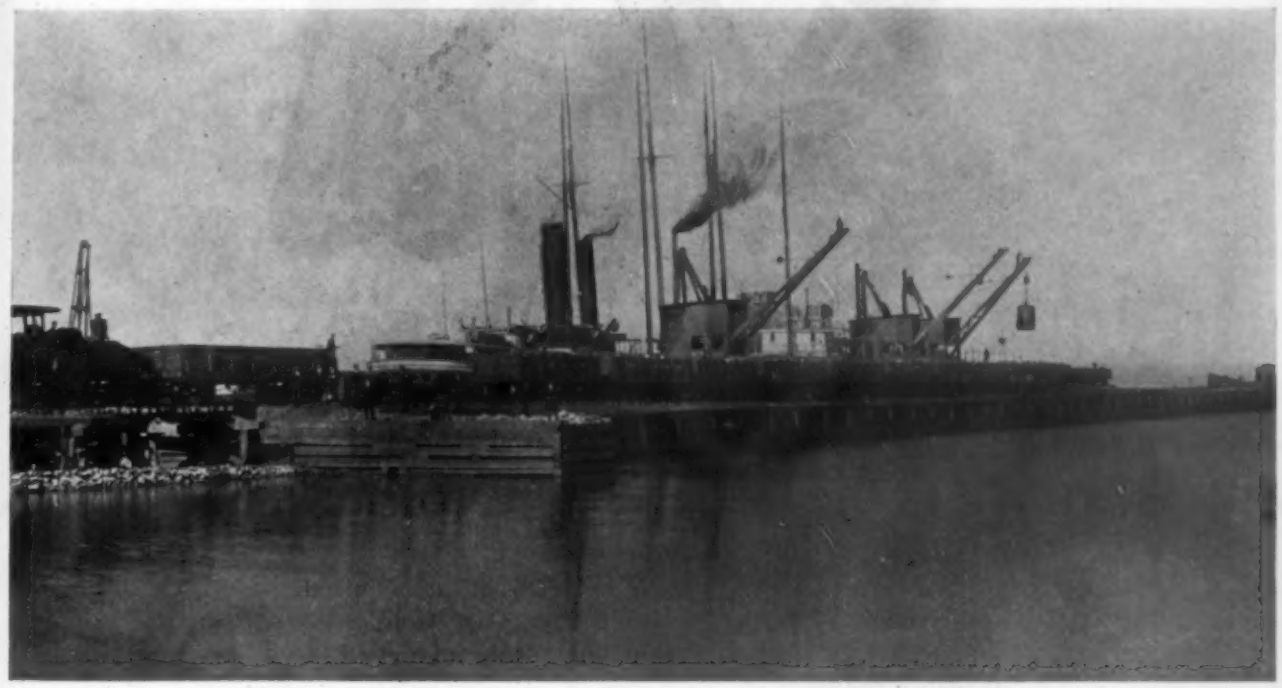

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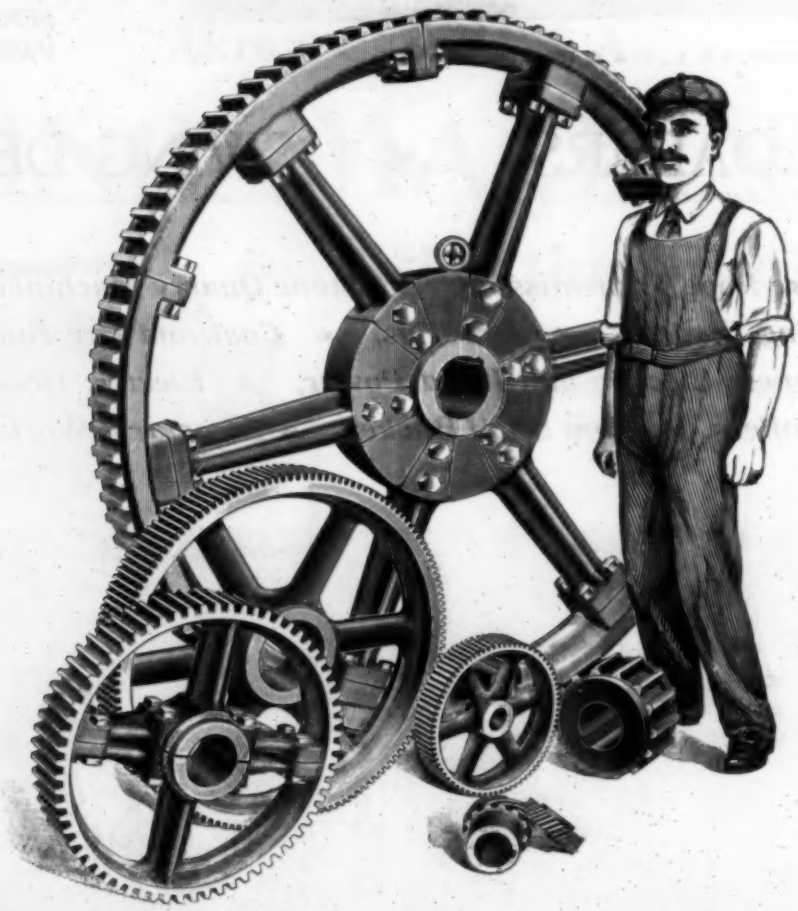

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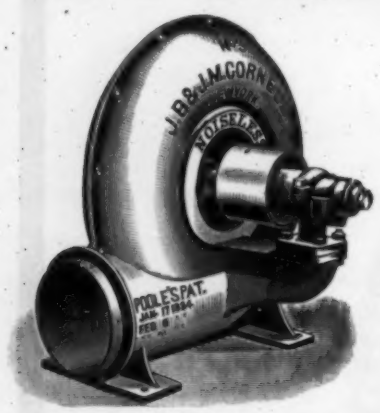

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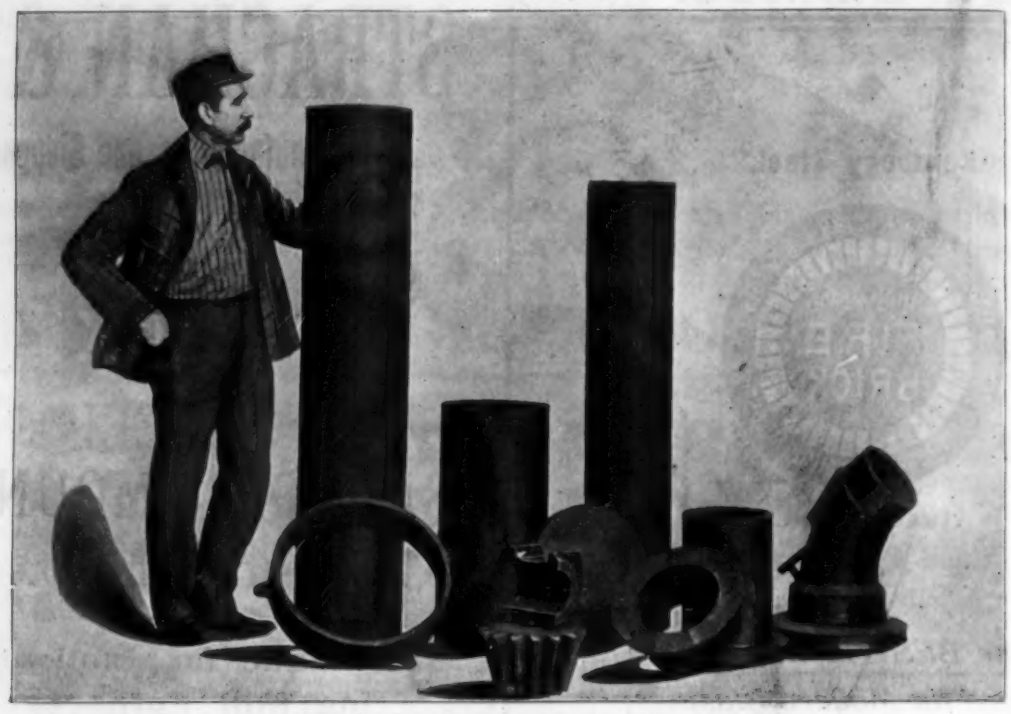

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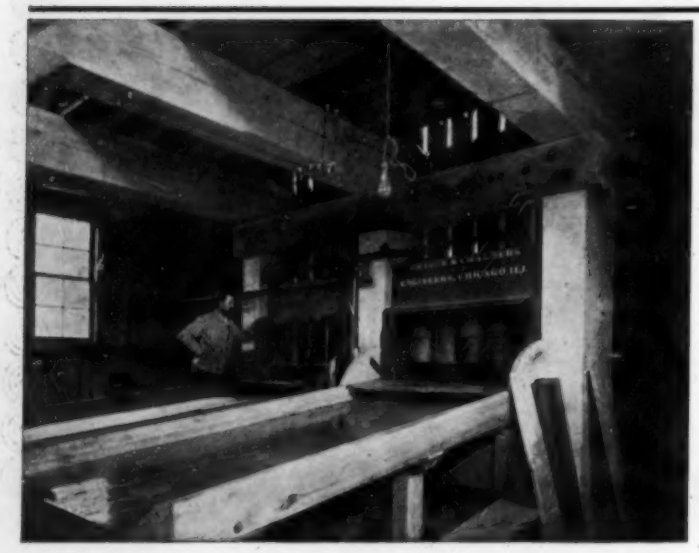

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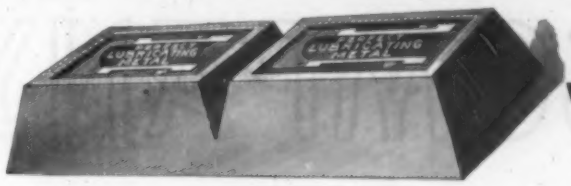
..ABSOLUTELY  WITHOUT A RIVAL!

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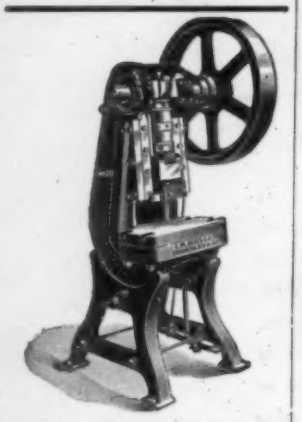

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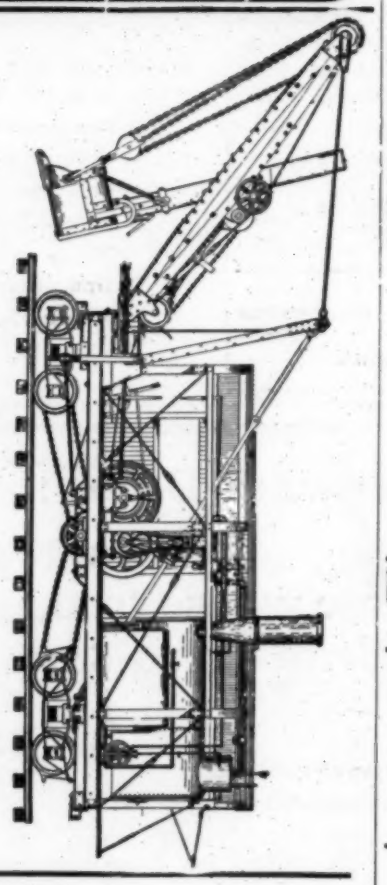

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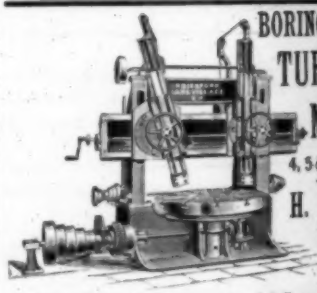

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